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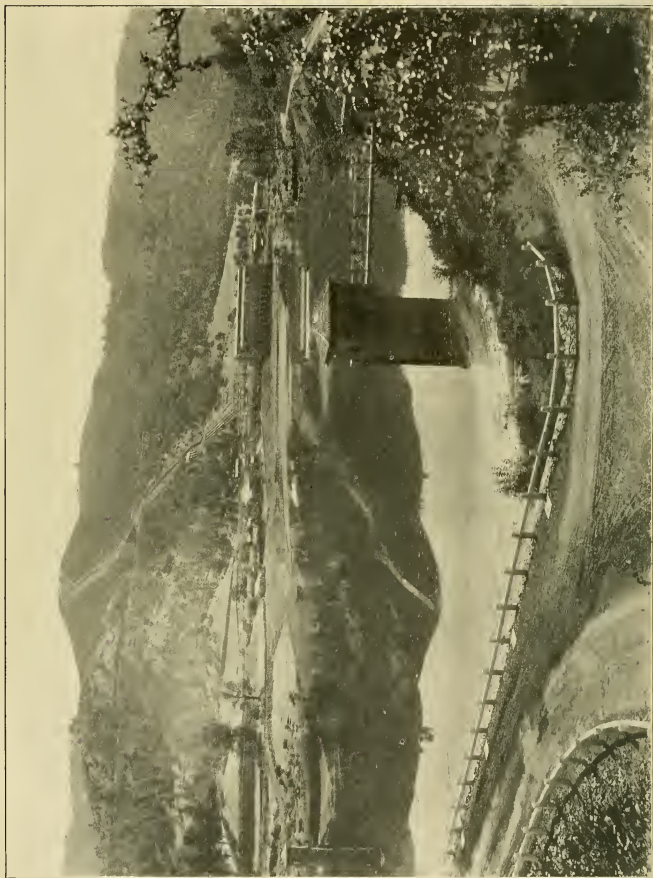
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MOCCASIN
General view of village from Moccasin Dam

ANNUAL REPORT
OF THE
BUREAU OF ENGINEERING
OF THE
DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF
SAN FRANCISCO



FISCAL YEAR ENDED JUNE 30, 1931



ANGELO J. ROSSI , , , *Mayor*

TIMOTHY A. REARDON

CHARLES E. STANTON

WILLIAM H. WORDEN

Board of Public Works

M. M. O'SHAUGHNESSY

City Engineer

Compliments of
M. M. O'Shaughnessy,
City Engineer.

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CITY AND COUNTY OF SAN FRANCISCO
DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERING

To the Honorable
The Board of Public Works of the
City and County of San Francisco.

Gentlemen:

Herewith I transmit the annual report of the Bureau of Engineering for the fiscal year ended June 30, 1931.

The boulevard construction program has advanced considerably, with completion of Alemany Boulevard, Section A, and a large part of Sunset Boulevard. Work has begun on grade separations on Sunset Boulevard at Sloat Boulevard and at Lincoln Way.

In the sewer construction program a number of main sewers have been built and good progress is being maintained on the College Hill tunnel sewer.

Progress at the Municipal Airport is seen in the purchase of lands and in the accomplishment of several contracts for improvements.

Islais Creek Reclamation District is an outstanding achievement. The construction work in progress will add much to the industrial facilities of the City.

An extensive program of street and boulevard work to relieve unemployment has been carried on under the direction of this office. As construction goes, a fairly efficient job was done, and great good came to many deserving persons.

The Hetch Hetchy Water Supply continues satisfactory operation of its power system and of the Bay Crossing Pipe Line which is leased to the Water Department.

Construction of the Coast Range Tunnels was seriously affected by an unexpected explosion in July, 1931, but nevertheless the tunnel progress for the year was approximately seven miles, making total progress to date 19.8 miles out of 28.5 miles. Concreting operations have begun near Tesla on a completed section of tunnel 4.4 miles in length.

Contract has been let for construction of the pipe line $47\frac{1}{2}$ miles in length across the San Joaquin Valley and studies are being made of a temporary pipe line and pumping plant to act as a by-pass of the Coast Range Tunnels to be completed by June of next year. This emergency construction has been compelled by unprecedented drought conditions.

Organization continues as during last year, with L. T. McAfee, Chief Assistant on public utilities, Clyde E. Healy, Second Assistant, in charge of local improvements, and Paul J. Ost, Electrical Engineer, on power and railway engineering. The other members of the efficient staff of assistants associated with me have functioned most efficiently. I trust that the new charter will not disturb their effectiveness.

I am indebted to L. B. Cheminant, Assistant Engineer, for preparation and compilation of this report.

Respectfully,

San Francisco,
July 31, 1931.

M. M. O'SHAUGHNESSY,
City Engineer.

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ORGANIZATION AND PERSONNEL

M. M. O'Shaughnessy.....	City Engineer
L. T. McAfee.....	Chief Assistant Engineer
C. E. Healy.....	Second Assistant Engineer
General City Engineering, Streets, Boulevards, Sewers, etc.	
W. H. Ohmen.....	Assistant Engineer
Design of Special City Projects, Airport, Structures, Boulevards, Sewers, etc.	
J. M. Owens.....	Assistant Engineer
Street Improvement Design	
W. C. Pidge.....	Assistant Engineer
Street Improvement Investigation and Permits	
L. R. Mercado.....	Assistant Engineer
Street Improvement Investigation and Permits	
E. E. Jordan.....	Surveyor
Street Improvement Assessments, Complaints, etc.	
G. F. Stahle.....	Surveyor
Street Grades	
H. J. Stahle.....	Chief Surveyor
Surveys	
P. J. Ost.....	Electrical Engineer
Electrical and Street Railway Engineering	
L. W. Stocker.....	Assistant Engineer
Water Supply Engineering	
L. B. Cheminant.....	Assistant Engineer
Reports, Publicity, etc.	
M. J. Bartell.....	Hydraulic Engineer
Special Investigations of Water Supply	
H. W. Kephart.....	Purchasing Agent
Water Supply Purchasing, Correspondence, etc.	
J. J. Phillips.....	Right of Way Agent
Lands and Rights of Way	
C. L. Cook.....	Engineering Chemist
Chemical and Testing Laboratory	
H. B. Chaffee.....	Photographer
Photography and Blueprinting	
F. O. Shutts.....	Assistant Engineer
Supervising Streets and Sewer Construction	

ORGANIZATION AND PERSONNEL—(Continued)

C. M. Taylor.....	Assistant Engineer
Supervising Major Local Construction, Boulevards, etc.	
F. J. Sheehan.....	Assistant Mechanical Engineer
Supervising Street Railway Construction and Maintenance	
L. Glick.....	Assistant Engineer
Contract Payments, Payrolls	
C. R. Rankin.....	Construction Engineer
Supervising Construction of Coast Range Division of Hetch Hetchy	
L. A. McAtee.....	Construction Engineer
Supervising Construction of San Joaquin Pipe Line of Hetch Hetchy	
Thornton Easler.....	Assistant Electrical Engineer
Supervising Power Operation of Hetch Hetchy	
Willis O'Brien.....	Auditor
Hetch Hetchy Water Supply, Accounting and Payrolls	

Retirement

Retired for Service:

I. J. Ohman, Assistant Civil Engineer.....March 1, 1931

Report of the Bureau of Engineering

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF SAN FRANCISCO

1930 - 1931

BOULEVARDS, STREETS, AND HIGHWAYS

Boulevard Construction Out of Bond Issues:

As was noted in the Annual Report for the fiscal year 1929-1930, construction of the boulevards under the bond issue authorized in 1927 had then come to such a stage that seven of the nine projects authorized were in use. During the past fiscal year all of the remaining sections of Alemany Boulevard, except one, have been thrown open to public use, and satisfactory progress has been made in the purchase of lands necessary for the completion of the extension of Van Ness Avenue from Mission Street to Howard Street. Sunset Boulevard is now open for traffic for almost its entire length and its completion is expected within a short time. On a number of the new boulevards the temporary pavement, which was laid on sections of subgrade liable to settlement, is now ready to be replaced by permanent pavement.

The lower roadway of Great Highway has been permanently paved for its entire length of two miles from Lincoln Way to Sloat Boulevard.

The long standing controversy about type of electroliters for use on boulevards has been settled, as will be noted in the article "Boulevard Lighting Standards."

The status of construction of boulevard projects under bond issues is as follows:

Bay Shore Boulevard 3.01 miles long, from Potrero Avenue to the County line, with 100 ft. roadway and two 12½ ft. sidewalks is complete and open to traffic. In some portions of this boulevard there is temporary pavement which later will be replaced by permanent pavement.

Alemany Boulevard extends along the old right of way of Ocean Shore Railway from Bay Shore Boulevard up the valley of Islais Creek, over the summit at Ocean View to Junipero Serra Boulevard, a distance of 4.8 miles. The boulevard consists of an 80 ft. roadway and two 10 ft. sidewalks.

Section A extends 7100 ft. from Bay Shore Boulevard to Mission Street Viaduct. During the year the storm drain in this roadway, which was noted under construction in last year's report, was completed, as will be noted under "Sewers." This was followed by grading of roadway and laying of temporary pavement on top.

Section B from the viaduct to Ocean Avenue, 3900 ft. in length, was noted last year as completed. However a contract will soon be let for



ALEMANY BOULEVARD, SEC. A

construction of the portion beneath and immediately adjacent to the Mission Viaduct.

Section C, 7800 ft. long, from Ocean Avenue to San Jose Avenue at Plymouth Avenue, is still incomplete. It has been deemed advisable to allow the fill to settle further before pavement is laid. A portion of this section, however, will receive permanent pavement under a contract for which bids are to be received July 15, 1931.

Of the alternative sections, D and D-1, from San Jose Avenue to Orizaba Avenue, respectively 1630 ft. and 2192 ft., construction is still being withheld on the former, while the latter is complete.

Section E, from Orizaba Avenue to Junipero Serra Boulevard, has already been noted as complete.

Junipero Serra Boulevard, 1.8 miles in length, from Sloat Boulevard to San Mateo County line, consists of a 100 ft. roadway and two 12½ ft. walks. This boulevard is complete and serves a very useful purpose in providing an outlet from the city connecting with the main state highway, El Camino Real, which leads to all points south.

The southerly extension of this boulevard into San Mateo County will be discussed under "Joint Highways."

Nineteenth Avenue Extension, 1.3 miles in length, from Sloat Boulevard to Junipero Serra Boulevard at Worcester Avenue, was noted as complete last year.

Sunset Boulevard occupies the entire block 240 ft. in width between Thirty-sixth and Thirty-seventh Avenues. The boulevard is centrally located, 2.1 miles in length, from Lincoln Way at Golden Gate Park to Sloat Boulevard. A southerly extension .4 mile in length, leads to a junction with the boulevard around Lake Merced, a portion of which has been completed, as will be noted under "Road and Boulevard Work to Relieve Unemployment."

The boulevard has been divided into five sections, A, B, C, D and E, to facilitate construction work.

Section A extends from Lake Merced Boulevard to Yorba Street, a distance of 1500 ft. The construction was undertaken by crews mobilized to relieve unemployment. Clearing of extensive groves of eucalyptus trees has been almost completed and a small amount of grading has been done. It is planned to discontinue work very shortly.

On May 20, 1931 twenty-one bids were received for construction of Sloat Viaduct. These ranged from \$169,339.70 to \$115,433.44, the lowest being that of Mission Concrete Company, to whom the contract was awarded. The work is now being laid out. This viaduct is of the most modern type and provides a cloverleaf grade separation, Sloat Boulevard being carried over Sunset Boulevard.

Section B extends 3400 ft. from Yorba Street to Santiago Street. Contract was awarded to Meyer Rosenberg on September 10, 1930 in the



SUNSET BOULEVARD

estimated amount of \$83,766.00. The contractor expects to complete the work on July 7, 1931.

Section C extends from Santiago Street to Noriega Street, a distance of 3400 ft. Contract for its construction was awarded to California Construction Company on October 8, 1930 in the estimated amount of \$103,-844.00. It is expected that the work will be completed during July, 1931.

Section D from Noriega Street to Irving Street, a distance of 3400 ft., is under construction by California Construction Company, to whom a contract was awarded September 24, 1930 in the estimated amount of \$104,-276.00. Completion of this work is expected within the next few days.

Section E extends from Irving Street to an intersection with South Drive in Golden Gate Park, a distance of 1000 ft. There will be a grade separation by means of concrete viaduct at Lincoln Way. As a preliminary to this viaduct construction it is necessary to divert the Lincoln Way sewer, which at this point is 6' 6" circular. This work is now under construction and will be noted under "Sewers." Plans are completed for the viaduct.

Provision has been made so that the roadways may be widened to 50 ft. in the future. The roadways are edged with unarmored concrete curbs. The minimum radius of curb returns is 25 ft. The roadway pavement consists of 2½ inch asphaltic concrete wearing surface on a 10 inch waterbound macadam base constructed in two 5 inch courses. The asphaltic concrete wearing surface is spread and finished with a mechanical spreader. The 15 ft. pedestrian path is paved with 4 inch waterbound macadam edged with redwood headers. The equestrian path is similar to the walks except that the waterbound macadam pavement is 6 inches in thickness.

The parking area, which is being developed under direction of the Park Commission, is covered with 8 inches of loam and 1½ inches of manure.

The boulevard traverses the undeveloped sand dunes near the ocean beach, where heretofore considerable difficulty has been had from drifting sands. As a defense against encroachment of sands the cut slopes along Thirty-sixth and Thirty-seventh Avenues are sown with barley seed in the amount of one pound to 600 square feet and then covered by using a light harrow or a brush drag. The sown area is then covered with hay, loosely spread, using one ton per ten thousand square feet. A small amount of sand is spread on the hay at frequent intervals. This method of prevention of sand drifts has been quite successful in other places in the sand dunes.

Conduits have been installed for the traffic signal system and electroliers for lighting will be erected along the central park strip at intervals of 115 ft.

A pipe and sprinkler system was installed under one contract, which was let after the grading contracts. A 4 in. water main extends along the center line for the entire length of the boulevard. Risers from this, which reduce eventually to ¾ in. pipe, lead to lawn sprinklers and to an occasional drinking fountain.

The cost of land acquisition for Sections B, C, D and E was approxi-

mately \$1,500,000. The land for Section A was acquired by the City in the purchase of the Spring Valley Water Company system.

In the block between Lincoln Way and Irving Street it was necessary to purchase and remove 28 dwellings.

The construction of Sunset Boulevard has stimulated public activity in the region adjacent to the work and a great many residences are now under construction.

Ocean Beach Esplanade was noted in last year's report as completed. This provides a paved and parked area 4298 ft. in length along the Ocean Beach frontage from the Cliff House southerly past Golden Gate Park.

Great Highway extends from Golden Gate Park to Sloat Boulevard along the ocean beach, a distance of two miles. The greater part of this was noted as complete in last year's report, and work was then under way on paving of the lower roadway, a 40 ft. road, 9750 ft. long. The contract was let on January 10, 1930 to Federal Construction Company and was completed in August, 1930.

Two comfort stations, on which construction was noted last year as 55% complete, were completed by Clinton Stephenson Construction Company on August 16, 1930.

The necessity of further extension of the sea-wall built as part of the Ocean Beach Esplanade was well exemplified by the encroachment of the ocean on the Taraval Street underpass at Great Highway. Shore eddies, set up during a heavy storm, began an encroachment on the beach and lowered the natural sand levels 10 feet. This persisted after the storm and was stopped only by great effort. The measures adopted, that is driving sheet piling and placing riprap, were done at an expenditure at least equal to the original cost of the underpass. Sea-wall construction is very expensive and it has always been with great difficulty that money for this purpose has been secured by appropriation of the Supervisors. This office is now engaged in a study for progressive construction of the sea-wall. Work on the important initial unit, which will protect the upper road, may be undertaken at an early date and its cost defrayed out of the portion of the 1927 bond fund set aside for Great Highway construction.

Van Ness Avenue Extension from Mission Street to Howard Street has progressed materially. Purchase of lands has been completed and contract for the pavement of the roadway was awarded June 24, 1931. This pavement work is to be done at the expense of the property owners. The pavement will consist of 6 inches of concrete base, 1½ inch asphalt binder and 1½ inch asphalt wearing surface. Curbs will be of concrete.

Bernal Cut, the ninth boulevard bond project, was noted in last year's report as complete, except for additional walks and planting.

Boulevard Construction Out of Gasoline Tax:

Laguna Honda Boulevard, on which the temporary pavement was noted as complete in last year's report, is now ready for permanent pavement.

Plans and specifications are under way and it is expected that this work will be done during the present year.

Portola Drive, from Twenty-fourth Street to Fowler Avenue, a distance of 3950 ft., was noted as having received its temporary pavement. After settlement during the coming winter, it is expected that the fills will be ready for this work. Plans and specifications for this work are under way.

It is planned to widen the remaining portion of Portola Drive, that is from Woodside Avenue to Sloat Boulevard, a distance of 7000 ft., to a width of 100 ft. to accommodate the very heavy traffic which reaches it from Market Street Extension. This widening would be a proper charge out of gasoline tax funds.

Road and Boulevard Construction to Relieve Unemployment:

The City of San Francisco took prompt measures to relieve unemployment during the business depression. On February 6, 1931, at a special election, the voters authorized the issuance of bonds for three purposes, as follows:

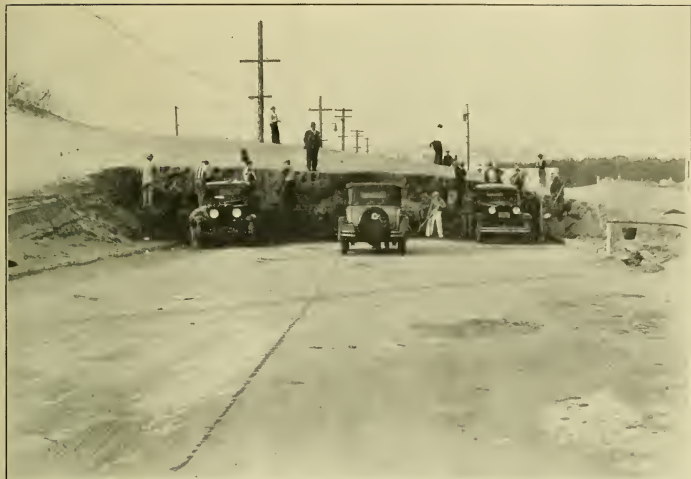
1. Improvement of Paths and Roads in Public Parks and Squares.....	\$1,400,000
2. Construction of Roads and Highways.....	900,000
3. Improvements in Public Playgrounds.....	200,000
Total.....	\$2,500,000

Prior to sale of bonds the city advanced sufficient money to begin the work. The bonds sold at a substantial premium. For some time a registration of unemployed citizens had taken place in the City Hall and it was the aim to employ only these men for two weeks continuously at a rate of \$4.50 per day for common labor, then to replace them with another contingent, in other words to rotate labor.

The labor was very inefficient, but fairly satisfactory progress was made in several of the projects outlined. At the present time the funds remaining are depleted to such an extent that on July 3, 1931 work will be discontinued on most of the jobs.

Bernal Heights Boulevard is probably the most striking of these jobs. The boulevard encircles Bernal Heights, the eminence which lies south-east of the Mission District. A roadway of approximately 5,000 ft. length is under construction here. The entire hill is rock and the roadway is made largely in cut in cherts and sandstone with steep rock slopes. There are two 7 ft. sidewalks and a 36 ft. roadway. The grading was done largely by hand labor although in the heavier cuts use was made of a steam shovel and several motor trucks. The view of the city from this boulevard can hardly be excelled as the Bernal hill occupies a central strategic vision point and it will be the more appreciated in that the Heights have been visited by relatively few San Franciscans.

For right of way, 93 lots and 25 houses were purchased at a cost of \$71,789.



Removing sand from paved street



Sand dunes planted to wire grass to prevent drifting
WORK TO RELIEVE UNEMPLOYMENT

Clarendon Avenue Extension is a roadway leading from the present termination of Clarendon Avenue near Stanyan Street north of Twin Peaks reservoir through Sutro Forest southwesterly to a junction with Laguna Honda Boulevard, a short distance northerly from Forest Hill station. The road is 60 ft. in width, 3940 ft. long and descends generally on a 10% grade. It traverses the old eucalyptus grove known as Sutro Forest. More than 1000 of these trees, about 65 years old, were cut to 4 ft. lengths, split and piled for use of the Water Department and the Laguna Honda Home. The stumps were blasted and removed to piles for burning. A 12 inch sewer pipe line was constructed, consisting of 1300 ft. of vitrified clay pipe and 500 ft. of cast iron pipe near the reservoir. All necessary catch-basins, culverts, and manholes were built. The road at present is about 95% complete, the remaining portion being a rock cut close to Laguna Honda, that is now being excavated by steam shovels and trucks. The rock surface of the roadway has not yet been rolled.

Lake Merced Boulevard is a roadway extending around the two arms of Lake Merced near the southerly boundary of the County. The boulevard will have a total length of approximately 5 miles but at present only 0.6 mile is under construction. This unit extends from the southerly end of Section A of Sloat Boulevard in a westerly direction to a junction with Skyline Boulevard. During clearing operations 680 eucalyptus trees were cut, split and piled. The right of way is 100 ft. wide and the paved roadway 60 ft. Pavement consists of 10 inches of waterbound macadam (red rock) with redwood headers. This will eventually be the base upon which asphaltic top will be laid for the final boulevard. The work is very good and the surface is quite satisfactory for vehicular traffic.

Stanley Street Parkway is the Panhandle approach to Lake Merced Boulevard from Alemany Boulevard at Orizaba Avenue. At present grading is being done on the easterly portion of this parkway.

Miscellaneous jobs done by the "Unemployed" include: Corbett Road, placing 1700 lin. ft. of 6 in. tile drain in 4 ft. trench which later was back-filled with crushed rock; Golden Gate Heights, Twin Peaks Boulevard, Laguna Honda Boulevard, Mt. Davidson, etc., stairways cleaned, guard fences repaired, slopes redressed, trails cleaned, gutters reestablished; Sutro Forest, 3 miles of fire trails cleared and widened for use of Fire Department; Sunset District, about 4 miles of streets cleared of sand and further protected by planting 750 acres of sandhills to barley and to wire grass. About 400,000 cu. yds. of sand were removed by hand labor and small trucks.

Boulevard and Highway Construction by Joint Highway Districts:

It is the belief of most citizens that all road construction is done by federal, state, county or city governments, but there are other units, the Joint Highway Districts, that are accomplishing much in major highway construction.

These districts are constituted by virtue of an Act of the State Legislature approved in 1917 and amended in 1921, 1925 and 1927, which provides

that joint highway districts composed of two or more counties may be created for the purpose of constructing certain highways. The districts are formed by resolution of the county Boards of Supervisors, from whose membership the District Directors are chosen by the respective boards. These District Directors form an executive body transacting the business of the district as a public corporation under the designation "Joint Highway District No. of the State of California." The districts take numbers in order of their creation by filing the resolution of confirmation by the Counties with the Secretary of State. The Secretary of State assigns the number to the district and issues a certificate of organization.

There are now sixteen districts organized under the state law, of which three include San Francisco County as member. These districts are No. 9, No. 10, and No. 16. Such incidental funds as are necessary are provided by authorization of the Counties' Supervisors from their portion of the State gasoline and motor vehicle tax.

For construction of the highway, the Directors have power to assess the State, the several Counties in the district and such lands as may be benefited by the highway. After review by the State Board of Control, these assessments are mandatory. The Directors are authorized to make necessary surveys and plans and invite bids and to let contracts for construction.

Upon completion of the contract, inspection of the work is made by the Advisory Board of the State Engineering Department which thereupon may issue a certificate of completion. The completed road may then be apportioned to several counties in the district, or be accepted as a whole or in part as state highway. Proper conveyance of all interest and rights of way that the district may have, must then be made by the Directors of the district to the Counties or the State.

Upon the formation of the local districts Nos. 9 and 10, it was anticipated that bonds would be issued under the provisions of the Act. These bonds were called revenue bonds and were predicated upon the receipt of revenues from taxation levied on the Counties. The tax is limited to five cents on \$100 of assessed valuation, apparently a rather insignificant amount, but capable of financing a \$1,700,000 project over a minimum period of five years, by San Francisco County alone. The legality of this provision was upheld in a test case in Ventura County which established the Districts' right to issue bonds.

The program of construction adopted by the two districts is first to construct the more important or vital portions of the highway in such a way that relief is afforded where it is in greatest demand. Other units are to follow as funds are made available until the entire project is brought to completion.

Ocean Shore Highway is a reconstruction of the present narrow and crooked county road which parallels the ocean shore from San Francisco to Santa Cruz. Joint Highway District No. 9 of the State of California, composed of San Francisco, San Mateo, and Santa Cruz Counties, was formed



OCEAN SHORE HIGHWAY
Old railroad grade along San Pedro Point

for the construction of this road, and these counties will contribute, respectively, 55%, 30%, and 15% of the cost, which is preliminarily estimated at \$6,000,000.

The engineering is done by the County Surveyors of San Mateo and Santa Cruz Counties. This office made all preliminary studies and participates in all engineering conferences.

The new road will take off from the Skyline Boulevard, approximately two miles south of the San Francisco-San Mateo County Line. From this point it will descend to the old roadway of the abandoned Ocean Shore Railway which it will follow in a general way to Santa Cruz.

The length of the new highway will be 74 miles which is about 17 miles shorter than the existing road. The right of way will be 100 ft. wide, with a 40 ft. roadway. For many miles it follows along precipitous rocky slopes, which call for very heavy construction but, to a great extent, the roadbed of the old railway will be used. The view afforded from this highway will easily rival any marine drive in the State.

The Directors have selected for initial construction the most vital units, that at San Pedro Mountain, which consists of about 5 miles of road between Rockaway Beach and Farallone City, and at Waddell Beach, about 6 or 8 miles in length, which will avoid the curves and grades over Ginoni Hill on the road through Swanton. Other units planned are the 2-mile section connecting Junipero Serra Boulevard and Skyline Boulevard south

of the San Francisco County line, the realignment of the section 2 or 3 miles in length extending from the Skyline Boulevard south to Salada Beach road, the construction of a road along the old railway right of way in the vicinity of San Gregorio and Pescadero, and permanent improvement of the road along the Waddell Beach bluffs. The present County Road is to be used wherever the alignment and grades are consistent with first class highway design. The construction work will be done under a series of contracts, the costs of which are to be defrayed by assessments levied against the counties from time to time.

The first work undertaken is the San Pedro Mountain unit, about five miles in length, between Rockaway Beach and Farallone City. It was planned to use the abandoned roadbed of the Ocean Shore Railway for this distance, grading it initially to 25 ft. width and even using the old tunnel at Point San Pedro, which is about 500 ft. in length. The timbering is in good condition except at the portals which have caved and will require reconstruction.

The roadway rises on a 2% grade through the tunnel to a summit at Point Rogers ("Devil's Slide") whence it descends to a long fill at Farallone City. The old railroad bench is about 200 to 300 ft. above the ocean on a steep, rocky slope. In many places the old roadbed has slid entirely into the ocean and full reconstruction will be required for the new road.

As noted in last year's report, condemnation proceedings for the required right of way were instituted on June 23, 1930. The Superior Court of San Mateo County set a value of \$112,000 which the District Directors thought was excessive, considering the fact that expensive reconstruction work is required on the old railroad roadbed. The value set by the court was fixed largely by the evidence introduced by the owners, Ocean Shore Railroad and the McNee Estate Company, who considered the railroad as of possible useful service in hauling redwood products from the region southerly from Pescadero to San Francisco.

An odd feature of the ownership of this land is the fact that several years ago the McNee Estate agreed to give the right of way to the Highway District when the latter should be ready to proceed with construction of the road. In consideration of this promise the land has been assessed by San Mateo County at but a nominal figure. Since the failure to acquire the right of way from the estate, the San Mateo County Supervisors, sitting as a Board of Equalization, have raised the assessment on this property.

When the Ocean Shore Railway was about to discontinue operation, a number of the coast residents raised by subscription a fund of \$150,000 with which it was proposed to buy the entire railroad with rolling stock and all facilities and present it to one of the railroads operating out of San Francisco for that company to operate. The negotiations failed because the company did not consider that the railway could be operated at a profit.

Following the court decision the Highway District abandoned the route along the old railroad roadbed and began to seek for an alternative route. Two such are under consideration and at this time, as surveys are about

to be made of these alternative routes, the owners of the original route sought by condemnation have indicated their willingness to compromise on price and negotiations are now under way.

Considerable difficulty was met in collecting the assessment originally levied for the San Pedro Mountain unit. With a 40 ft. roadbed, the cost was estimated at \$670,000. On account of the difficulty of collection, District Engineer Kneese submitted a revised report for a 25 ft. roadbed at an estimated cost of \$180,000 for units A and B.

An informal agreement was reached at a Directors' meeting by which \$88,000 was to be raised to begin contract work on unit "A" at a cost of \$120,000.

Santa Cruz County paid \$11,000, and San Francisco County paid \$35,000 under this agreement, but on account of legal difficulties, the payment of \$42,000 by San Mateo County has not yet been made. Meanwhile, the contract let to A. J. and J. L. Fairbanks, Inc., has been cancelled on account of the high cost of the right of way, which will no doubt take the bulk of the funds on hand.

By reorganizing under the new Joint Highway District Act, signed by the Governor in June, 1931, the way will probably be found out of this financial tangle, as the procedure in financing has been greatly simplified in this new Act.

Junipero Serra Boulevard Extension. This boulevard begins at the San Francisco-San Mateo County line at the southerly end of Junipero Serra Boulevard and extends well south into San Mateo County, lying approximately midway between El Camino Real and Skyline Boulevard, back of the cemeteries. Its construction as far as Burlingame, a distance of 11 miles, at an estimated cost of \$2,500,000, is being undertaken by Joint Highway District No. 10. San Francisco, which is obligated to pay 85% of the cost, has two directors, while San Mateo County has one. The City Engineer of San Francisco is Chief Engineer.

The boulevard will be graded to full ultimate width through all built-up areas. Right of way is 125 ft. wide to provide for a 100 ft. paved roadway and two sidewalks 12½ ft. wide. Beyond the built-up areas, the roadway will conform to the standard of the existing state highway, El Camino Real. Here the initial width graded is 75 ft., of which 40 ft. is paved to provide four traffic lanes with peak capacity of 3200 vehicles per hour. The paved roadway may be widened to 60 ft. when traffic justifies it. Grade separation is planned at Washington Street, Colma, where local traffic will pass over the boulevard. Grade separation may be necessary also at Millbrae Avenue. Joint Highway District No. 10 ends at Burlingame.

From Burlingame to Alameda de las Pulgas, at Belmont, a 7 mile gap exists. Half of this distance is through some of the highest class residential tracts in the state. To preserve the values of these properties it will probably be necessary to make a parkway from 200 to 300 ft. wide, which will cost \$3,000,000 or more per mile for lands and construction.

San Mateo Creek crossing will require a high viaduct. Eventually the boulevard will be extended to San Jose.

The schedule of construction is laid out on the installment plan in similar manner to that of Ocean Shore Boulevard, that is, there are a number of units of construction, the most vital being undertaken first. For construction purposes this boulevard has been divided into three sections. Section 1 extends about $3\frac{1}{2}$ miles in a southeasterly direction from the county line to a junction with El Camino Real at Baden. Section 2 extends 4 miles from Baden to San Bruno, and Section 3 is $3\frac{1}{2}$ miles long from San Bruno to Burlingame.

The estimated cost of Section 1 was \$800,000, an amount that it was difficult to finance at one time. This section was therefore divided into three units, A, B, and C. Unit A from the County line to School Street, was noted in last year's report as completed. Traffic counts here show 4,000 to 5,000 vehicles daily during week days and up to 20,000 on holidays; this in spite of an objectionable right angle turn at the School Street termination. With the construction of the other units this traffic will undoubtedly increase so that this boulevard will be one of the most important peninsular arteries.

Unit B is $\frac{2}{3}$ mile in length from School Street to Edgemar Road. Assessment for its estimated cost of \$230,000 was made March 20, 1931. San Mateo County's share, \$23,000, was paid in advance. The State Department of Public Works agreed to pay one-third of the cost or \$76,667. San Francisco's share \$140,000, is not yet available, due to depletion of the gasoline tax fund. Purchase of rights of way, estimated at \$90,000 is going ahead satisfactorily, plans and specifications are ready, and contract should be entered into before the end of this summer.

Unit C extends from Colma to Baden, with a connection to El Camino Real. Efforts are now being made to finance the purchase of rights of way for this unit and for Sections 2 and 3 extending to Burlingame. It is essential that these purchases be made soon to avoid rise in prices due to subdivision of the lands, and that the construction proceed rapidly, as the boulevard will soon be urgently needed.

North Shoreline Joint Highway District. Efforts were made to form a joint highway district for construction of a road from the Golden Gate, along the Bolinas Ridge, and then following the shore line to join the Redwood Highway at Ferndale, near Eureka. The district was to consist of San Francisco, Marin, Sonoma, Mendocino, and Humboldt Counties. Due to the fact that there were no data on hand to form a basis of cost, the district never progressed beyond tentative formation.

One unit of the proposed highway is a bridge crossing Russian River at Jenner, near the ocean. Joint Highway District No. 16, known as Russian River Bridge Crossing District, was formed to construct this unit. The component counties and the State contributed funds for this work as follows: Marin \$12,500, Sonoma \$85,000, Mendocino \$12,500, San Francisco \$15,000, and the State of California \$65,000.

Contract was let early this year to Rocca and Calletti for \$151,000 to construct a 900 ft. steel bridge and roadway approaches. Upon its completion in September, 1931 the old ferry will be discontinued.

It is understood that the Highway District will cease to function upon completion of this unit of construction.

Miscellaneous Street Construction:

Again the amount of street work done has diminished. Pavements and sewers have been built in many streets of the westerly part of the Sunset District. Extensive grading and planting of the sand dunes are now under way and many residences are being built on the new streets. Grading and paving were done in Castro Street Addition and Glen Park Terraces under the district assessment plan. In the Marina District a new subdivision resulted in \$137,000 worth of grading, paving, and sewers. In the vicinity of Harrison and Second Streets, grading and spur track construction have been done to create an industrial district.

In Golden Gate Heights the main drives are being paved with asphaltic concrete on the flatter grades and with emulsified asphalt on the steeper grades, to provide ready means of travel from the Nineteenth Avenue portion of the Sunset to the vicinity of Ninth Avenue.

The Street Repair Department has continued its policy of replacing basalt block central strip with concrete pavement.



GRADING FOR INDUSTRIAL SITES ON RINCON HILL
Hawthorne Street north from Harrison Street

Most of San Francisco's streets are of generous widths. The entire system consists of 870 miles of streets laid out, of which 634 miles are paved. The cost of the pavements cannot be well determined but probably exceeds \$35,000,000.

Widening Streets:

Widening of roadways and narrowing of sidewalks by setting back curbs have continued during the year. Most of this work is done by the Street Repair Department. Some of the roadways widened are shown in the following list:

Alpine Terrace.....	14th Street to Duboce Avenue
Ocean Avenue.....	Plymouth Avenue to Fairfield Way
Scott Street.....	Fell Street to Hayes Street
Bartlett Street.....	21st to 22nd Street
Fair Avenue.....	Mission Street to Coleridge Street
Broadway.....	Octavia to Fillmore Street

Several major projects for street widening by purchase of additional land are now under consideration by this office. These will be mentioned under "Major Traffic Plan."

Special Treatment Improvements:

Minor street improvements which vary from the customary design and require separation of roadways, construction of walls, stairs, etc., are referred to as "Special Treatment Improvements." Such improvements are constantly being brought forward by hillside residents, generally with the object of obtaining financial aid from the municipality.

The status of these improvements is shown below:

Construction Begun or Completed During the Year:

	Estimate
Carolina St., 22nd to 23rd St.....	\$23,000
Fairmont St., Bemis to Laidley St.....	4,000
Fremont St., Harrison to Bryant St.....	35,000
Golden Gate Heights paving.....	50,000
Montcalm St., Peralta Ave. to Isabel St.....	5,500
Roosevelt Way, Henry St. stairs.....	1,700
Joost Ave. Slide, drains and grading.....	8,000
Montgomery St., Union to Greenwich.....	62,000

Plans Completed, Construction Not Begun:

Golden Gate Park, Fulton St., and 24th Ave. to Lincoln Way and 19th Ave.....	60,000
Golden Gate Park, North Drive, Stanyan St. to Funston Ave.....	40,000
Houston St., Jones St. to Columbus Ave.....	3,500
Hyde St., Chestnut to Bay St.....	28,000
Union St., Montgomery to Calhoun St.....	15,000
Preventorium Road, San Mateo County.....	60,000

Plans Under Way:

Bernal Heights, Stoneman, Bonview, Coso.....	30,000
Campbell St., Alpha to Goettingen St.....	.....

Street and Boulevard Lighting:

The two-year controversy of members of the Board of Supervisors over selection of a type of lighting standard was settled as noted in last year's report by a compromise which called for construction of concrete and metal standards in the ratio of one to two.

Bids for standards for all boulevards built out of bond funds were received on specifications prepared by the City Engineer covering eighteen different types of construction designated by Resolution of the Board of Supervisors. Contract for 300 centrifugally spun concrete standards with bronze trimmings was awarded to NePage McKinney Company at an average price of \$66 each. Contract for 600 wrought and cast iron standards was awarded to Taper Tube Pole Company of San Francisco at an average price of \$85.05 each. The combined amount of the two contracts is \$70,831.

Both types of standards carry a single upright unit at a height of 20 ft. to light center. The concrete standard consists of an octagonal shaft with an octagonal base molded to pleasing lines. The shaft is surmounted by an ornamental bronze casting which bears the lighting unit.

The metal standard is made from machine fluted sheet steel welded to form a shaft. This is welded to a heavier pipe section which is set into a concrete base. The shaft is galvanized to prevent deterioration of the sheet metal. A base and a top casing of cast iron are used as trimming.

Conduits for electrical connections for the standards have been included in most cases in the contract for construction of the boulevard. Separate contracts for construction of foundations for the standards, for extension of the conduits into these foundations, and for furnishing and installing the wiring and the luminaires have been awarded as follows:

Boulevards	Number of Standards	Contractor	Contract Price
Bay Shore.....	244 metal	R. Flatland.....	\$22,778
Bernal Avenue.....	39 "	Butte E. & M. Co.....	4,340
{ Lower Road, Grt. Highway	53 concrete	R. Flatland	
{ Laguna Honda Boulevard	22 "	"	9,489
{ Junipero Serra.....	85 "	Alta Elect. Co.	
{ 19th Ave. Extension.....	55 "	"	14,940
Portola Drive	36 metal	Weidenthal-Gosliner	
		Electric Works.....	4,024

The contracts awarded for standards will also provide for Alemany Boulevard, Sunset Boulevard and the Upper Road of Great Highway.

In general these standards are spaced approximately 130 ft. on the center line of the street and are staggered, except on Bay Shore Boulevard where they are placed opposite each other. The lamps used are rated at 10,000 lumen. The Pacific Gas and Electric Company will supply the electrical energy and maintain the system under its annual contract with the Board of Supervisors.

At the request of the Supervisors' Lighting Committee the subject of new lights on Van Ness Avenue has been given consideration and designs

for brackets to go on the existing oramental concrete trolley poles have been prepared and submitted together with estimates of cost.

The property owners on Hyde Street from Market Street to California Street, by petition, formed an assessment district to supply adequate lighting for their street.

The installation consists of seventy-six contrifugally spun concrete, single light, upright, street lighting standards, six to the block, placed in a staggered arrangement. The lamps used are 6,000 lumen with a height of 16 ft. 3 ins. above street surface. The spacing is approximately 110 ft. on each side of the street.

This work including furnishing and installing standards complete with lamps and fittings, and all necessary underground conduit, was placed in service late in December, 1930. The cost of the work was \$18,371.15.

TRAFFIC: SIGNS AND MARKERS

Traffic Engineering:

During the past fiscal year traffic engineering has been handled by the Police Department, assisted by an assistant engineer in this office.

Specifications and plans were prepared by the City Engineer's office for Traffic Buttons, Zone Markers, Stop Signals and Wiring, etc., totaling \$120,000.

Street Signs:

Two types of street signs are used in San Francisco. "Type A" sign consists of four enameled plates with white letters on a blue background, erected on a suitable metal standard. "Type B" sign is a single plate attached to the wall of a building or structure in a similar position of visibility.

"Type A" signs are set usually one at an intersection, but on the wider or more important intersections two and sometimes even four signs are set. "Type B" signs are set on small streets and alleys.

Until this year the annual appropriation for street signs has been \$10,000. This sum has been reduced to \$5,000. During the year, 126 "Type A" signs were erected under Contract 10 at a cost of \$2,016, making to date a total of 4291 "Type A" signs in the city. The remainder of the appropriation has been used in maintenance, repairs, and painting of the existing signs.

The number of "Type B" signs remains 675, as no new signs of this type were erected during the year.

SPECIAL PROJECTS AND INVESTIGATIONS

Major Traffic Street Development:

For some time the office has been engaged on a study of future traffic requirements with the aim of development of major traffic streets. The complete schedule is not intended to be accomplished at one time, but is progressive and may extend over five-year periods and may be changed from time to time.

Due consideration has been given to providing means of reaching the bridge heads of both the San Francisco Bay Bridge and the Golden Gate Bridge, both from points without and within the city. Upon the opening of the bridges to traffic, additional development may be necessary, possibly involving grade separation.

The plan contemplates the widening of some roadways by setting back curbs, the widening of existing streets by purchase of additional property, and the development of new streets.

The units suggested at present for first development are:

Army St., widening to 100 ft.....	Est. Cost,	\$1,050,000
San Jose Ave., widening to 100 ft.....	" "	650,000
Bay St., widening to 100 ft.....	" "	573,000
Third St., widening to 100 ft.....	" "	925,000
Golden Gate Park Panhandle Extension (Properties only).....	" "	3,100,000
Duboce Ave., extension.....	" "	No estimate
Capp St., widening to 305 ft.....	" "	8,000,000
Harrison St., widening to 150 ft.....	" "	No estimate
Nineteenth Ave., widening to 100 ft.....	" "	1,300,000
Potrero Ave., extension.....	" "	No estimate

The units for secondary development are numerous streets that are destined to become main traffic arteries. Growth of the city in directions not now anticipated may possibly cause a revision of these units before the time of their development actually comes, therefore they are not enumerated here.

This Street Development Report was transmitted to the City Planning Commission, which furnished a copy to the San Francisco Traffic Survey Committee, a quasi-public body supported by various down town interests.

Garbage and Refuse Disposal:

In last year's annual report was noted the appropriation of \$10,000 for investigation by this office of foundation conditions and preparation of plans and specifications for the construction of a refuse incinerator at the present site at Fifteenth and De Haro Streets.

The foundation tests showed that piling was unnecessary and indicated a safe maximum bearing pressure of four tons per square foot.

The completed plans and specifications (No. 18,261) for an 800-ton incinerator were transmitted by the City Engineer to the Board of Public

Works on August 14, 1930. The cost of the plant, exclusive of land, was estimated as follows:

Building, foundations, ramps, loading platform.....	\$ 498,500
Furnaces and appurtenances, including chimneys.....	525,500
Auxiliary equipment.....	16,000
Total	\$1,040,000

This represents a cost per ton of \$1,300, which compares favorably with the 73d Street plant of New York City at \$2,450, the Goose Island plant of Chicago at \$1,370, the Brooklyn plant at \$1,831, and the Wellington Street plant of Toronto at \$1,375.

The Board of Public Works by Resolution No. 111,436 on August 20, 1930, transmitted copies of the above plans and specifications to the Supervisors for approval, with recommendations that bidders submit proposals on their own plans and specifications, which should conform as nearly as practicable to those prepared by the City Engineer, and that these be prepared by the bidder without any charge to the city.

It must be noted that these proceedings were in accordance with the Supervisors' Ordinance No. 8738 of April 14, 1930, which declared, among other statements, that it was their intention to receive bids for construction and operation of an incinerator, along with an exclusive privilege of incinerating the city's refuse for a 25-year period.

In the meantime, at the instance of the Health Committee, the Supervisors went through the various formalities necessary for submitting to the people the issuance of bonds for constructing an incinerator, so, eventually, on September 24, the Board of Public Works rescinded Resolution No. 111,436 which had transmitted for approval the above plans and specifications.

The Supervisors on September 8, 1930, adopted Resolution No. 3308, declaring the necessity of bonds for incinerator construction. Under their Declaratory Ordinance No. 8833 of August 11, 1930, the City Engineer had on September 27 transmitted to the Board of Public Works for approval and for transmission to the Supervisors, plans and estimates for the acquisition, construction, and equipment of a garbage and refuse incineration plant. The estimate of cost was as follows:

1. Construction as enumerated above.....	\$1,040,000
2. Purchase of property.....	125,000
3. Demolishing present incinerator.....	7,000
4. Street improvement.....	13,000
5. Contingencies	15,000
Total bond issue.....	\$1,200,000

Plans and specifications for this work, presented by the City Engineer on September 24 to the Board of Public Works were in turn transmitted the same day to the Supervisors and were by them approved on September 29, 1930, on condition that such approval would not debar subsequent bids on other plans for an incineration plant.

At a meeting of the Board of Supervisors on September 25, 1930, in discussion of the resolution providing for the sale of an incineration franchise, it was clearly shown that a \$1,000,000 plant could not profitably be operated under the provisions of the initiative ordinance which fixes the price of disposal at not to exceed \$1 per ton.

In the election of November 4, 1930, the bonds for construction of an incinerator failed to carry. The vote was: For, 83,885; against, 49,601. A two-thirds vote is necessary to issue bonds.

The Board of Supervisors on December 12, 1930, passed a resolution providing for the sale of a garbage destruction franchise and advertised for bids to be opened on January 12, 1931. Out of seven bids received, four were declared illegal on account of various omissions and irregularities. Two of these bids were for disposal by dumping at sea, while the other was for destruction by incineration.

At a meeting of the Health Committee on February 5, it developed that the incineration bid was for combustible wastes only, and segregation of refuse would be required of the householder. No provision had been made for disposal of ash. In a report to the Supervisors on February 23, the City Engineer declared that it was not to the best interests of the city to award the contract to the bidder on incineration as his specifications were so worded as might involve the city in endless controversy. At about the same time the Assistant City Attorney ruled that the bid was illegal.

The City Engineer advised against both of the bids that proposed dumping at sea, and recommended that instead of considering bids for a franchise for such dumping, the Supervisors authorize the Board of Public Works to receive bids for sea dumping for a period of two years.

A conference was held in the office of Mayor Rossi on March 28, 1931, to consider protests of the fishing industry against dumping at sea, after which the City Engineer discontinued work on plans and specifications for this method of disposal.

The Supervisors passed Resolution No. 34,250 (New Series), approved April 21, 1931, which instructs the City Engineer and City Attorney jointly to prepare plans, specifications, resolutions, and advertisements for a franchise for disposition and destruction of refuse according to three alternative propositions:

- (a) For incineration and final disposal, according to plans and specifications by the City Engineer.
- (b) For incineration and final disposal, according to the bidder's own plans.
- (c) For other means of disposal except dumping at sea.

The necessary resolution, advertisement for bids, the specifications, and bidders' forms were prepared by the City Engineer, reviewed and approved by the City Attorney, transmitted to the Supervisors, and on June 22, 1931, the resolution, slightly modified, was finally passed and was approved by the Mayor as Resolution No. 34,580 (New Series) on June 23, 1931. It provides that bids be received on July 27, 1931.

The two bids for dumping at sea, received under the Street Railway Franchise Act, are still before the Supervisors.

The depreciated condition of the present incinerator led to a joint inspection on December 18, 1930, by representation from this office, the Fire Prevention Bureau, Board of Health, Department of Electricity, Bureau of Building Inspection, and the Scavengers' Union. A report was submitted next day to the Board of Public Works, recommending that certain work be done to mitigate the hazards of employment. This work was completed by the scavengers in February, 1931.

Last year's report states, referring to the present antiquated incinerator: "Judge Mogan, on June 5, 1929, had decided that the destructor is a nuisance and should be removed, but he withheld judgment to allow the City to determine what course to pursue. Judgment is still being deferred."

Sunnyvale Naval Air Base Site:

At the request of the Chamber of Commerce, this office conducted an investigation and prepared a report for the Navy Department covering additional test borings on the Navy Dirigible Air Base site at Sunnyvale.

Five test borings were made, and the record of a well was obtained.

These additional data were required on account of the contemplated shift in hangar location.

Boring indications were such as to compare favorably with borings previously taken. Firm clay was obtained at depths of from 15 feet to 40 feet.

Peninsula Grade Crossing Conference:

This office conducted investigations of grade crossings on the Peninsula from San Francisco to San Jose, and prepared and transmitted a report on the subject to Dr. W. F. Durand, of Stanford University, President of the Grade Crossing Conference, on behalf of the Committee on Technical Data of the Peninsula Grade Crossing Conference.

This work was of a very comprehensive nature, and contained data concerning 84 grade crossings from San Francisco to San Jose, 52 of which are in San Mateo County and 32 in Santa Clara County.

The report divided the crossings into two parts, i. e., those which should receive first attention, and those which should receive secondary consideration.

It was pointed out in the report that approximately 51 crossings could be eliminated, and that the cost of grade separation of the remaining crossings would entail a total expenditure of about \$9,000,000.

Atlas of Lands Owned by City:

An atlas with maps and descriptions of all municipally owned lands within the city was completed during the year. Each department received a copy of the portion of the atlas covering the properties under its jurisdiction, while copies of all volumes were given to the Right of Way De-

partment, City Attorney's office, and similar departments. Work is continued on this atlas from time to time to keep it correct to date.

The new Charter, which goes into effect on January 8, 1932, provides, "The director of property shall maintain complete records and maps of all real property owned by the City, which shall show the purchase price, if known, and the department in charge of each parcel, with reference to deeds or grants establishing the City's title."

Standardization of Construction Specifications:

The standardized specifications, noted in last year's report as completed, have been of great use and have saved much time in office and field. One assistant engineer is assigned to specification work. He keeps in touch with all improved methods as developed on other work and also keeps a close record of all city contracts, with special reference to time, progress, costs, quality of concrete, etc.

Mapping:

In addition to the maps which are hereinafter noted under "Surveys," the office has continued work on the following maps: San Francisco (detail) on scale of 1 in.=200 ft., Grade Map on scale of 1 in.=800 ft., Easements and Sewers, Bridges Maintained, Special Improvements and Easements, Miscellaneous Repairs, Street Signs Erected, and Street Signs Painted, all on the scale of 1 in.=1000 ft.

Studies of Sewerage Problems:

Attention is given intermittently to studies of sewage disposal. One particularly difficult problem is the proper disposition of sewage from the Baker's Beach Outfall. Conditions here are not at all desirable, and the time is coming when it will be necessary to make better provision for disposal at this point. The department has made studies, which are not complete, of a settling tank in an effort to obviate the nuisance.

STRUCTURES AND MISCELLANEOUS CONSTRUCTION

Islais Creek Reclamation District:

This District is an area of 280 acres of what was originally overflowed land and mud banks, where Islais Creek emptied into San Francisco Bay. This area is rapidly being reclaimed and is developing into valuable industrial sites with facilities for shipment by rail and water.

The development work, which is expected to be completed by the end of 1931, consists of the construction of a rock bulkhead wall, 2100 ft. in length, along the north side of Islais Creek Channel from Third Street to the trestle of Southern Pacific Railroad, and the filling to official grade of all lands and streets in the District. A wooden box drain, 3500 ft. in length, was built to carry the drainage of four square miles of the valley of upper Islais Creek. The estimated cost of the development is \$1,620,152. The funds were secured by assessment of the lands benefited, and work is progressing well inside estimates.

This District was created by special act of the State legislature, approved April 6, 1925, the legality of which was affirmed by the State Supreme Court in San Francisco, Case No. 11,948, decision dated January 21, 1927. The interests of the State are safeguarded by requiring that the Board of Harbor Commissioners approve the plans. Such approval was given April 29, 1927.

Assessment Commissioners were appointed and the assessment roll adopted. Suit was filed by H. A. Whitley, owner of a lot 50x100 ft., alleging that the assessment was inequitable and confiscatory, but judgment was given adverse to the plaintiff. The case is now on appeal to the Supreme Court.

The property owners of the District on September 4, 1928, by unanimous vote, decided to bond the District and proceed with the work. The District Trustees, Colbert Coldwell, Stuart F. Smith, and City Engineer M. M. O'Shaughnessy, decided to issue 6% serial bonds maturing \$162,152 on January 1, 1932, and \$162,000 annually thereafter to January 1, 1941.

The bonds were executed and deposited with the City Treasurer while the District brought suit to validate them. Demurrer was filed by H. A. Whitley, but the Court affirmed the validity of the bonds. Petition of Mr. Whitley for retrial was denied and he appealed to the Supreme Court. The bonds were purchased by American Securities Co., William Cavalier & Co., and Weedon & Co. for \$1,620,152 plus \$258 premium, plus accrued interest to June 30, 1930. The bonds were resold to yield from 5 to 5¼%, and have recently been quoted to yield 4.60%.

Bids were received July 10, 1930, for building 3465 ft. of 14 ft. x 8 ft. wood box drain and appurtenances, with 45,000 ft. of wood piling. Seven bids were received, ranging from \$120,568 to \$208,820, and contract was awarded to M. B. McGowan on July 12, 1930. The work was completed and accepted December 2, 1930 for total payment of \$120,860.55, while the estimated cost for assessment purposes was \$160,000.

The feature of the construction work was the installation of two



Pontoon bridge for truck haul



Rock bulkhead wall
ISLAIS CREEK RECLAMATION DISTRICT

30-inch Armco floodgates in a temporary bulkhead, which prevented the waters of the channel from flooding the trench while the drain was being built. Pay length of piles varied from 25 ft. to 165 ft., which latter required splicing of three piles. The splice consisted of a steel shell around well-trimmed piles, with steel pins driven through perforations in the casing into the piles.

Bids were received on August 11, 1930 for building 2100 ft. of rock bulkhead wall in trench. The bids were based on cost per cu. yd. for excavating trench and disposing of mud, and cost per ton for furnishing and placing rock bulkhead wall. Five bids were received, ranging from \$257,-615.625 to \$403,135.00, and the contract was awarded to Healy-Tibbitts Construction Co., the low bidder. The work was completed and accepted on April 10, 1931, with a total payment of \$287,738.71, while the estimated cost for assessment purposes was \$493,867, this latter figure based on delivery of material from outside the city. The low bid resulted from a reciprocal arrangement with the Western Pacific Railroad Co., which permitted the successful contractor to obtain satisfactory rock from the company's property on Army Street immediately adjacent to the District. Dredging costs were very low as all dredgers were idle until this work began.

The dredging was sublet to American Dredging Co., and the quarrying, hauling, and placing of the rock to J. P. Holland, Inc. The general contractor shifted the scows used as pontoons, as will be described below. The dredging was done by a 5-yd. and a 3-yd. clamshell dredge. Two tugs and four bottom dump barges, each of 380 cu. yds. capacity, were used to carry the excavated material to deep water off Hunter's Point—a $2\frac{1}{2}$ mile round trip—where it was dumped. About 12,000 cu. yds. per 8-hour shift were excavated and dumped.

The quarry rock is serpentinized peridotite. This was shot with 40% dynamite and black powder, and loaded into trucks by gas shovels of $1\frac{3}{4}$ and $1\frac{1}{2}$ cu. yds. capacity. Hauling was done by 12 trucks carrying 7 to 9 tons per load and making 35 to 40 loads per shift. Round trip haul was $\frac{5}{6}$ mile. The maximum amount of material handled per 2-shift day was 9000 tons.

The method of construction was as follows: The trench material was soft mud over blue clay. The dredger excavated this to the neat line of trench, the excavated material being towed to the channel and dumped. Barges 40 ft. wide, 108 ft. long, and drawing 4 ft. of water, were placed to act as pontoons to form a roadway over the side of which the trucks dumped into the trench. The barges were placed at the channel line and then shifted back and forth so as to spread a mat over the trench and then gradually build up the wall to the designed lines. The last 8 ft. of wall was built by running the trucks directly over the rock fill, dumping the rock and blading it into place. Eleven barges were used in the work. The trucks ran along the rock fill, thence along an apron on to the barges. The total cost of the contract was \$287,738.71 against an estimate of \$493,867 made for assessment purposes.

The filling of the land is proceeding rapidly and is now about 60% complete. Total estimated cost is \$866,285. The owners are being considered as contractors and are making a saving of about 20% on the fill estimates on the work they undertake.

M. H. Levy of this office is Engineer for the District.

San Francisco Municipal Airport:

Until the new Charter goes into effect the Airport will remain under jurisdiction of the Board of Supervisors. Conditions have continued as during previous years, with diminution of activity due to the removal of the fleets of the commercial transport lines to privately owned airports on the east side of the Bay. This condition is due to change, however, because the Century Pacific Lines Ltd. has chosen San Francisco Airport for its northern base and is inaugurating a 4 hour service to Los Angeles and San Diego, dispatching ships at frequent intervals and carrying passengers at a rate which compares very favorably with railroad and steamship fares.

As noted in last year's report the City is purchasing 1112 acres of land for \$1,050,000 to provide for future development of the Airport. The property being bought includes the present leased site of 150 acres and also a large area of submerged land which is to be reclaimed by dredging. The tract of 1112 acres has been divided into ten approximately equal areas, one of which is to be purchased each year for the sum of \$105,000. Parcel 1, the most northerly of the ten strips, was purchased in August 1930, and preparations are now under way to acquire Parcel 2, which is the most southerly strip. Funds for this purpose are included in the annual budget.

One of the urgent requirements is an extension of the field to the eastward, over the present submerged area, so as to give an effective landing



SAN FRANCISCO MUNICIPAL AIRPORT
Paved parking space. Offices at hangars

distance of at least 2500 ft. as required for first class rating by the United States Department of Commerce. The present width is about 1400 ft.

At the election of November, 1930 a proposition was submitted to the electorate to issue \$4,000,000 worth of bonds for purchase and development of the Airport along lines developed in this office. The vote was: For, 82,267; against, 55,513. The measure failed to carry the necessary two-thirds vote.

An agreement has been entered into with the Western Pacific Railroad Co. to provide a 65-ft. right of way through the Airport property on its west border along the Bay Shore Highway.

Some of the special events during the year were:

1930

July 7—Capt. Kingsford Smith of 'round the world fame, landed in his ship "Southern Cross."

Aug. 13-16—U. S. Army Air Corps used the field as a base for air maneuvers in cooperation with Navy planes. During this period 35 military planes were stationed at the field.

Sept. 26—Transatlantic fliers Coste and Bellonte landed at the field.

Oct. 29—"California Good Will Air Tourists," comprising 92 passengers in 30 ships, landed at the field.

Nov. 1-2—American Legion Air Show.

1931

June 29—Century Pacific Lines Ltd. brought 10 planes to the field to inaugurate service to Oakland, Fresno, Bakersfield, Los Angeles, and San Diego. The Company expects to begin service on July 5, making 6 trips daily in each direction between San Francisco and Los Angeles.

Construction work at the Airport during the year is as follows:

Contract 19: A 2-story frame annex to Hangar No. 2 was built, providing 2 light repair shops and 6 offices. The building has concrete floor, plaster interior, and stucco exterior. Cost \$21,800.

Contract 20: The existing levee along the bay shore repaired, the drainage gate outfall channels excavated, and a boat channel dredged, using a dipper dredge. Cost \$3,338.

Contract 21: The existing waterbound macadam parking space between the hangars and Bay Shore Highway was paved with asphaltic concrete and emulsified asphalt top. Cost \$6,500.

Contract 22: An additional pump and pipe line were installed to supplement the present facilities for unwatering the drainage ditch. Cost \$3,500.

Contract 23: A firehouse is under construction, together with alterations to Hangar No. 1, to provide a fire apparatus room, first aid room, sleeping quarters for fire marshal, offices, light repair shops, toilets and showers. Cost \$13,700.

Contract 24: Roof and apron floodlights and obstruction lights are being installed. Cost \$1,350.

Auxiliary Water Supply (High Pressure) System:

No extensions were made during the year which required planning from this office, although the Fire Department laid 200 ft. of 10-in. pipe on Falmouth St. from Folsom to Shipley. At the request of the Fire Department this office made estimates of cost for two extensions, one of which was to extend from Stanyan St. along the Clarendon Avenue extension through Sutro Forest to Laguna Honda. The estimated cost was \$18,524.89. The other proposed extension was from Divisadero St., via Pacific Ave., Lyon St., and Clay St. to Arguello Blvd., using 12-inch and 14-inch pipe. The estimated cost was \$29,083.88.

Both compartments of Twin Peaks Reservoir were emptied, cleaned, and overhauled. All valves and gates were inspected. This work was done by the Fire Department. Survey points were set on the division wall and observed at frequent intervals to determine if there were any deflection of the wall with one compartment of the reservoir full and one empty.

Third Street Bridge:

Previous reports have noted the fact of inadequate depth of water in Channel Street waterway where it is crossed by the Third Street bridge. Repairs to the existing bridge have limited this depth to 23 feet. The cost of a new bridge was preliminarily estimated at \$550,000, and efforts were made to raise this amount by contributions from the City, the Board of State Harbor Commissioners, and the railroads. Neither of the two railroads felt that it should contribute.

The United Fruit Co., which operates a fleet of steamers that dock in the Channel, has arranged to operate its steamers past this bridge. In view of this fact the Mayor and the Board of State Harbor Commissioners decided that immediate steps should be taken to facilitate this condition, and the Board signified its intention to participate in the financing to the extent of possibly one-half the cost of the new bridge, the city to pay the other half.

On April 29, 1931, six bids were received by the Board of Public Works for construction of the Third Street bridge, these bids being on three different types of structure, namely, American Bridge Company Abt type; Strauss heel trunnion type; and the Scherzer type. The low bidder was George Pollock Company with a bid of \$611,117 on the American Bridge Company type.

Inasmuch as the Board of State Harbor Commissioners will participate in the cost of the structure, it was necessary to submit the bids received to it for approval. The American Bridge Company type of structure was not satisfactory to that Board, which definitely stated that it would not participate in the cost of the work unless the Strauss type of bridge was used; the lowest bidder for this type thereon was Barrett and Hilp at \$644,280.

In order to expedite the matter and to start construction on this much delayed project as soon as possible, the Board of Public Works acquiesced

in the request of the Board of State Harbor Commissioners and recommended that the bid of Barrett and Hilp be accepted, instead of that of the low bidder.

Immediately thereafter, the lowest regular bidder, George Pollock Company, brought suit to set aside the award of contract to Barrett and Hilp as being irregular. This promised to cause very serious delay in construction of the bridge, so after further conferences between the Board of State Harbor Commissioners and the city, it was finally decided that the Board of Public Works should call for new bids on the Strauss type of bridge only. It thus became necessary for the Board of Public Works to employ the Strauss Engineering Corporation as consultant engineers. In accordance with this agreement, plans and specifications are now being prepared, and bids will be called for in the early part of September, 1931.

SEWERS

The San Francisco sewer system is what is known as a combined system, in which the domestic sewage and the storm water are carried in one conduit. The sewers are planned to carry to the outfalls all sewage proper, all infiltrated soil water, and runoff due to rainfall of $\frac{1}{4}$ inch in 24 hours. If the rainfall exceeds $\frac{1}{4}$ inch, which is usual about 26 days per year, the excess runoff due to the storm is diverted through storm relief outlets to flow through shorter relief sewers into bay or ocean. The sewage in these relief outlets is so diluted by the storm runoff that it is unobjectionable at the points of storm-water discharge. There are a number of relief outlets on the North Point main, one of which consists of three compartments 8' 3" x 9' 6".

The sewer system consists at present of about 97 miles of trunk sewers built by the municipality at a cost of about \$17,000,000. This does not include the cost of the ordinary small sewers which are installed under private contract at the expense of the owners of abutting property. Within the next fifteen years it will be necessary to expend \$14,000,000 for construction of major sewers.

Bond Issue Construction:

In the annual report for last year there was given a list of the sewers whose construction was planned out of the \$2,200,000 bond issue which was authorized at the election of November 6, 1928. This list enumerated the units of construction which were either under way or had been completed. The following were noted as not yet contracted for but with plans and specifications prepared:

	Length ft.	Size
Alemaný Storm Drain—Section C.....	915	8' 6" x 11' 0"
Alemaný Storm Drain—Section C.....	394	2' 6" x 3' 9"
Alemaný Storm Drain—Section D.....	1195	8' x 14' wood box
Alemaný Storm Drain—Section D.....	226	3' x 4' 6" wood box
Fifteenth St. Sewer—Section B.....	622	7' 0" Circular
Fifteenth St. Sewer—Section B.....	841	5' 6" Circular
Fifteenth St. Sewer—Section B.....	1309	5' 3" Circular
Fifteenth St. Sewer—Section B.....	576	5' 0" Circular
Fifteenth St. Sewer—Section B.....	631	4' 6" Circular
Fifteenth St. Sewer—Section B.....	145	3' 0" x 4' 6" Circular
College Hill Tunnel.....	4320	4' x 6' 6" Tunnel
College Hill Tunnel.....	1508	4' x 6'
College Hill Tunnel.....	318	3' 6" x 5' 3"
College Hill Tunnel.....	315	6' 0" Circular

Plans and specifications have since been completed for Fillmore Street Sewer, Section E, 2247 ft. of 5' 3" circular and 3' 6" x 5' 3"; Fifteenth Street Sewer, Section C, 1250 ft. of 9' 0" x 9' 6" two compartment.

The Alemaný Storm Drain is a relief outlet leaving the North Point Interceptor at the inlet end of College Hill Tunnel. Section B of Alemaný Storm Drain is double 8' 6" x 11' 0". Until now the drainage from the



Pile foundation for 2-compartment drain



Completed drain
ALEMANY STORM DRAIN

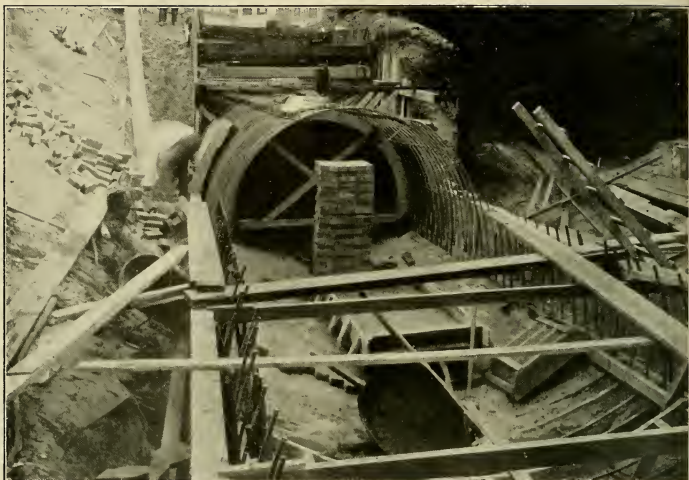
upper Islais Creek Valley has been discharging down Islais Creek from the end of the North Point main at the Mission viaduct and has constituted an extreme nuisance. Upon completion of the College Hill Tunnel this sewage will be carried through College Hill to enter the North Point main to discharge at North Beach. This storm drain was completed during the year, as was also the main wood box drain through Islais Creek Reclamation District.

Fifteenth Street Sewer, Section B, is now under construction and its completion is expected in the fall of 1931. This will relieve the flood condition that occasionally prevails at Market and Church Streets, where the existing sewers are not large enough to carry the storm waters.



SAN JOSE AVENUE SEWER

Portion of College Hill Tunnel contract; 4'x6' egg shape sewer in trench with maximum depth of 32 feet



LINCOLN WAY SEWER

Diversion of main sewer to allow grade separation at Sunset Boulevard,
7'3"x9' basket handle sewer

College Hill Tunnel:

Bids for construction of this tunnel were received by the Board of Public Works on September 17, 1930. There were seven bids ranging from \$251,617.00 up to \$327,574.00. Contract was awarded to T. E. Connolly, the lowest bidder, on September 24, 1930.

Tunneling operations are being carried on from a shaft 100 ft. deep, located at the Bernal Cut. Fourteen hundred fifty-seven feet have been driven south from the shaft and 1256 ft. north from the shaft. At the south portal driving was carried on for a short time, the total length driven being 351 feet. Tunneling conditions are ideal. The formations encountered are serpentine, sandstone, chert, and clay. About 20% of the tunnel is timbered.

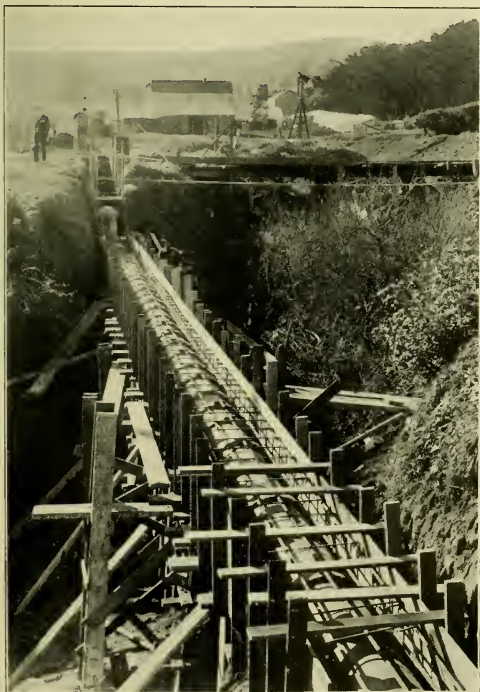
Lincoln Way Sewer Relocation:

It was necessary to relocate the 6'6" circular sewer on Lincoln Way at the intersection of the new Sunset Boulevard to prepare for the grade separation viaduct. The new bypass sewer lies within the edge of Golden Gate Park. It consists of 420 ft. of 5 ft. 6 in. circular sewer on a steep grade, and 920 ft. of 7 ft. 3 in. by 9 ft. basket handle sewer.

Current Construction:

There has been a small amount of construction of small ironstone pipe sewers in the streets which have been paved during the year. The work has been largely in the Sunset District where the bulk of the paving has gone ahead.

The budget appropriation of \$50,000 was used for laying sewers in front of City properties, for construction of an outlet for Army Street, and for extension of Bay View main and for reconstruction of two outfall structures in the Marina District.



PIPE SEWER ENCASED IN CONCRETE AND ON CONCRETE PILES

Side Sewers:

Permits issued from this office show a slight decrease from the previous year, as shown in the following tabulation:

Month 1930	Orders	Collection
July	61	\$ 4,527.75
August	48	3,771.25
September	79	6,162.25
October	76	5,456.00
November	52	3,308.75
December	53	4,273.10
1931		
January	48	5,691.00
February	37	2,283.35
March	66	4,595.50
April	68	5,780.75
May	63	6,386.25
June	81	5,867.00
Total	732	\$58,102.95

Design and Construction:

The entire design of all local improvements, such as boulevards, tunnels, sewers, airport, and reclamation, the special studies such as refuse disposal, major traffic plan, etc., are in immediate charge of W. H. Ohmen. Construction of major works is directly under Chas. M. Taylor, while F. O. Shutts is in charge of minor projects. Engineering for the Municipal Railway is in charge of P. J. Ost, with F. J. Sheehan supervising railway construction and maintenance.

STREET WORK PERFORMED UNDER CONTRACTS

July 1, 1930 to June 30, 1931

Asphaltic Concrete Pavement:	Quantity Unit	Cost
8" Concrete base, 1½" wearing surface, 1½" binder	1,723,728 sq. ft.	\$536,868
6" Concrete base, 2" wearing surface.....	1,080,262 sq. ft.	266,383
6" Concrete base, 1½" wearing surface.....	469,944 sq. ft.	146,747
3" Black base, 1½" wearing surface.....	102,348 sq. ft.	28,388
9" Macadam base, 2" wearing surface.....	7,495 sq. ft.	1,005
8" Macadam base, 2½" wearing surface.....	52,230 sq. ft.	6,268
8" Macadam base, 2" wearing surface.....	152,871 sq. ft.	13,488
3" Macadam base, 2" wearing surface.....	10,926 sq. ft.	1,093
2" Asphaltic wearing surface on existing base	138,116 sq. ft.	15,659
2" Asphaltic wearing surface, 3½" binder....	1,464 sq. ft.	293
1½" Asphaltic wearing surface 1½" binder....	25,812 sq. ft.	3,182
Wearing surface to conform, etc.....	141 tons	1,019
Wearing surface to conform, etc.....	33,283 sq. ft.	3,864
Asphalt (emulsified) Pavement	131,534 sq. ft.	987
Asphalt (emulsified) Sidewalk	30,283 sq. ft.	2,090
Basalt Block Pavement	504 sq. ft.	226
Brick (Vertical Fiber) Pavement	522 sq. ft.	228
Concrete Pavement, 6"	468,840 sq. ft.	119,717
Macadam Pavement	205 cu. yds.	300
8" Waterbound macadam, oiled surface.....	133,744 cu. yds.	13,473
4" Waterbound macadam walk.....	3,009 cu. yds.	68
Coping, concrete 10"	11,053 lin. ft.	11,045
concrete 6"x 14"	3,130 lin. ft.	1,252
concrete on sidewalk.....	1,633 lin. ft.	1,633
concrete on fence.....	3,347 lin. ft.	5,355
Curb:		
Granite, new.....	450 lin. ft.	500
Granite, reset	1,835 lin. ft.	478
Concrete, new.....	140,839 lin. ft.	113,256
Concrete, reset	10,563 lin. ft.	4,787
Gutters, concrete	16,183 lin. ft.	8,177
Headers, redwood	7,522 lin. ft.	1,117
Bulkheads, wooden	395 lin. ft.	680
Railings, pipe	610 lin. ft.	243
Fence, concrete rail	3,627 lin. ft.	10,420

	Quantity Unit	Cost
Sidewalks, one-course concrete.....	145,411 sq. ft.	\$ 18,512
two-course concrete.....	430,019 sq. ft.	59,419
6" concrete.....	1,402 sq. ft.	308
Walls and Stairways, Class B concrete.....	11,046 cu. yds.	204,159
Wall and Balustrade, concrete.....	45 lin. ft.	450
Concrete, Class E.....	67 cu. yds.	941
Reinforcing Steel.....	1,396,955 lbs.	53,185
Cement Plaster.....	936 sq. yds.	1,077
Basalt Block Rubble Walls.....	4,060 lin. ft.	17,052
	67 cu. yds.	737
Basalt Block Rip Rap Sloping.....	-----	4,822
Wire Fencing.....	3,262 lin. ft.	3,001
Bronze Bearing Plates.....	44 only	11,544
Sprinkler System.....		3,792
Planting Ice Plant.....	85,438 sq. ft.	2,067
Planting Lawn.....	98,194 sq. ft.	4,910
Piles, Concrete.....	13,935 lin. ft.	24,368
Wooden.....	291,766 lin. ft.	95,773
Traffic Control:		
Warning Lights and Reflectors.....	12 only	198
Reflectors, 9-unit.....	3 only	220
Traffic Beacons.....	16 only	3,914
Arterial Stop Signs.....	39 only	726
Signal Foundations.....	5 only	1,070
Traffic Lanes Painted.....	6,509 lin. ft.	108
Pedestrian Lane Markers.....	9,859 only	648
Traffic Turning Buttons.....	78 only	59
Pull and Junction Boxes.....	60 only	1,560
Conduit, 1½" and 2" Pipe.....	77,156 lin. ft.	37,212
Cable, Lead Covered, with No. 10 or No. 12 twin conductor.....	10,385 lin. ft.	1,375
Grading, Cut.....	588,067 cu. yds.	264,091
Embankment or Fill.....	233,444 cu. yds.	48,256
Miscellaneous, Grading and Clearing.....	-----	14,697
Paving.....		11,454
Traffic Control.....		5,110
Undistributed.....		30,877

Sewers, Concrete:	Quantity Unit	Cost
2 Compartment 8'-6½" x 11'.....	1,327 lin. ft.	\$130,399
8'-6½" x 12'.....	3,043 lin. ft.	151,350
8'-1½" x 10'-3".....	3,092 lin. ft.	123,859
8'-6" x 6'-6".....	941 lin. ft.	38,600
6'-9" circular.....	4,492 lin. ft.	148,330
6'-6" circular.....	3,814 lin. ft.	100,243
6'-0" circular.....	747 lin. ft.	19,784
4' x 6'.....	1,766 lin. ft.	39,210
3'-6" x 5'-3".....	706 lin. ft.	10,230
3'-0" x 4'-6".....	808 lin. ft.	8,990
2'-6" x 3'-9".....	2,547 lin. ft.	28,072
2' x 3'.....	1,710 lin. ft.	17,979
Sewers, Vitrified Clay Pipe:		
24" diameter.....	29 lin. ft.	124
21" diameter.....	2,793 lin. ft.	5,766
21" diameter in concrete.....	312 lin. ft.	1,869
Sewers, Vitrified Clay Pipe:		
18" diameter.....	2,777 lin. ft.	7,350
15" diameter.....	9,560 lin. ft.	21,215
12" diameter.....	38,204 lin. ft.	52,513
10" diameter side sewer.....	230 lin. ft.	270
8" diameter.....	30,247 lin. ft.	37,930
8" diameter side sewer.....	273 lin. ft.	330
6" diameter side sewer.....	37,930 lin. ft.	38,535
Sewers, Wooden Box:		
14' x 8'.....	1,195 lin. ft.	33,835
3' x 4'-6".....	194 lin. ft.	1,552
Drain, Open Ditch.....	725 lin. ft.	302
Y and T Branches:		
21" x 6".....	67 only	309
18" x 6".....	86 only	134
15" x 6".....	227 only	431
12" x 6".....	1,020 only	1,239
8" x 6".....	838 only	942
Special Structures, Tapers, Junctions.....	17 only	13,900
Manholes:		
On Concrete Sewers.....	106 only	7,452
On V. C. P. Sewers.....	387 only	33,848
On Wood Box.....	4 only	240
Manholes:		
Rebuilt.....	2 only	135
Drop, new.....	1 only	284
Lampholes.....	2 only	100

Underdrain, Culvert, etc.:		Quantity Unit	Cost
12" diameter V. C. P. underdrain.....	1,193 lin. ft.	\$	1,613
10" diameter V. C. P. underdrain.....	4,368 lin. ft.		5,184
8" diameter V. C. P. underdrain.....	8,504 lin. ft.		7,651
6" diameter V. C. P. underdrain.....	6,142 lin. ft.		5,180
6" diameter V. C. P. drain tile.....	9,848 lin. ft.		2,200
4" diameter V. C. P. drain tile.....	4,185 lin. ft.		1,465
10" diameter V. C. P. culvert.....	13,654 lin. ft.		12,083
8" diameter V. C. P. culvert.....	135 lin. ft.		68
36" diameter corr. iron pipe culvert.....	305 lin. ft.		3,665
12" diameter Class B cast iron pipe.....	52 lin. ft.		104
6" and 4" cast iron pipe.....	117 lin. ft.		138
Catch Basins, new.....	396 only		34,023
reset	75 only		4,630
Storm Water Inlets.....	7 only		279
Miscellaneous Sewer and Drainage Work.....			25,216
Total			<u>\$3,429,131</u>
Summary:			
Public Contracts		\$	587,715
Private Contracts			263,655
City Pay			<u>2,577,761</u>
Total			<u>\$3,429,131</u>

Note: Some of the work included in this tabulation was actually completed during the preceding fiscal year, but not reported until early in the present year. The work done by Islais Creek Reclamation District is not included in this tabulation.

STREET IMPROVEMENT ASSESSMENTS, ETC.**Assessments and Bonds for Street Work:**

Assessments issued for cost of street work performed.....	64
Cost of street improvements covered by assessments.....	\$ 303,297.60
Bonds prepared (in triplicate).....	179
Amount of assessments guaranteed by bonds.....	\$ 60,091.61
Average amount guaranteed by each bond.....	\$ 335.71
Receipts for bond payments issued.....	2,145
Amount of bond payments collected.....	\$ 97,526.21

Street Work Proceedings:

Resolutions of Intention passed.....	37
Street improvements recommended under Resolution of Intention	131
Notices of street improvements posted.....	1,356
Notices of Resolution of Intention mailed.....	1,336
Ordinances ordering performance of street improvements passed	61
Proposals for street improvements published.....	115
Public contracts for street improvements published.....	93
Private contracts filed.....	103

Public Proceedings for Sidewalks:

Contracts formulated.....	31
Surveys made.....	28
Examination sheets made.....	16

Notices, Permits and Investigations:

Notices to construct and repair sidewalks.....	850
Notices to construct bulkheads.....	184
Notices to remove obstructions.....	168
Notices to obtain curb lowering permits.....	186
Notices to construct guard rails.....	6
Notices to obtain oil tank permits.....	90
Notices to reconstruct side sewers.....	18
Notices to obtain street space permits.....	499
Street space permits reported on.....	1,581
Oil tank permits reported on.....	476
House moving permits reported on.....	54
Miscellaneous calls and investigations.....	2,714
Blasting bonds set and jobs supervised.....	22

Permits and Fees for Corporation Trenches and Main Line Extensions:

	Number of Permits	Mains Lineal Feet	Fees
Pacific Gas & Electric Co.....	3,711	138,211	\$ 6,638.50
San Francisco Water Department.....	3,217	83,852	5,174.00
Pacific Telephone & Telegraph Co.....	215	16,753	480.00
Great Western Power Company.....	3		4.50
Western Union Telegraph Company.....	3		4.50
	7,149	238,816	\$12,301.50
*Special Deposits			\$ 2,008.00

*Permits granted for miscellaneous purposes, e. g., move steam shovels and tractors, install or repair oil tanks, service pipes, fire alarm wires, cables, and conduits, to lower curbs, etc.

SURVEYS

Surveys Performed:

For public contracts.....	77	
For private contracts.....	124	
Resurveys for contracts.....	86	
For Municipal departments.....	294	
	<hr/>	
Total for public improvements.....		581

Lot Surveys:

For private owners.....	7	
For Municipal departments.....	23	
	<hr/>	
Total lot surveys.....		30
		<hr/>
Total surveys.....		611

Surveys include approximately 1187 blocks and crossings, a total of about 330,000 feet or about 62½ miles, in addition to about 45 miles of highway and monument lines and the placing and replacing of 190 monuments.

The surveys include:

Junipero Serra Boulevard Extension from County line southerly.
 Islais Creek Reclamation District.
 Industrial Street Sewer.
 Castro Street Extension, Duboce to Divisadero Street.
 Baker and Pierce Streets Outfall Sewers.
 Illinois Street Widening, Fourth Street southerly.
 Golden Gate Park Roads.
 College Hill Sewer Tunnel.
 Sunset Boulevard, Lincoln Way to Lake Merced.
 Lake Merced Boulevard.
 Bernal Heights Boulevard.
 Clarendon Avenue Extension through Sutro Forest to Laguna Honda Boulevard.
 Alemany Boulevard.
 Lake Merced Panhandle from Orizaba Avenue to Skyline Boulevard.
 Golden Gate Heights Pavement.
 Twin Peaks Reservoir Test Points.
 Bernal Cut.
 Harding Boulevard Subsidence.
 Bay Shore Boulevard Light Standards.
 Great Highway Study of Water Action.
 Laguna Honda Boulevard for Subsidence.
 Laguna Honda Boulevard Light Standards.
 Portola Drive Light Standards.
 Junipero Serra Boulevard Light Standards.
 Nineteenth Avenue Extension Light Standards.
 Two Jail Sites.
 Sloat Boulevard and Sunset Boulevard Underpass.

Precise Level and Bench Marks:

	Bench Marks	Distance Miles
University Mound Tract.....	291	7.60
Visitation Valley Tract.....	270	6.60
Other Districts	163	4.70
Excelsior Tract.....	488	10.80

Precise Level and Bench Marks—(Continued):

	Bench Marks	Distance Miles
Bernal Heights Tract.....	572	12.20
Lake Merced District.....	42	2.30
Parkside District.....	310	6.50
Forest Hill District.....	122	2.80
Sunset District.....	1,409	29.90
Total.....	3,667	83.40

Maps Approved and Recorded:

1. Peabody Street Extension from Sunny Dale Avenue southerly.
2. Laguna Honda Boulevard from Dewey Boulevard northwesterly.
3. Rousseau Street Extension from Bosworth Street northerly.
4. Lansdale Avenue at Juanita Way.
5. Sherwood Forest.
6. Miraloma Park Subdivision No. 7.
7. Westwood Highlands Blocks 2990 to 3006-A.
8. The Marina Gardens and vicinity.
9. Beach and North Point Streets opening from Buchanan to Webster Street.
10. Tara-Louisburg and Margaret Avenue realignment.
11. Chenery Street widening from Fairmount to Natick Street.
12. Campbell Avenue and Somerset Street widening.
13. Miraloma Park showing opening of street.
14. Shipley Street extension between Fourth and Fifth Streets.
15. Rae Avenue extension from Whipple Avenue southerly.
16. Rockridge Terrace.
17. Twenty-fourth, Twenty-fifth and Twenty-sixth Streets opening.

Of the above-mentioned maps, eleven were prepared and made in this office, the other five, which are subdivision maps, were checked as to location of streets, ties to adjacent tracts, monuments, and other legal requirements.

Fees Received for Surveys and Inspection:

Year	Month	Surveys	Inspection
1930:			
	July	\$ 842.40	\$ 2,682.60
	August	2,183.25	2,414.00
	September	1,105.50	1,930.90
	October	659.80	3,183.05
	November	708.05	2,495.40
	December	1,234.15	3,388.90
1931:			
	January	788.60	12,477.50
	February	495.10	3,227.30
	March	1,107.75	4,557.85
	April	120.05	1,541.50
	May	1,337.61	7,936.00
	June	306.70	2,891.15
Total.....		\$10,888.96	\$48,726.15

STREET RAILWAYS

Unification:

Although changed in some respects through the adoption of Charter Amendment No. 35 described below, the street railway problem is still with us. The unification of the three local systems as a single municipally owned and operated property seems no nearer accomplishment than it was exactly ten years ago when, as the first step toward the acquisition of the Market Street Railway, this office began the preparation of a very complete and detailed valuation of that property.

It is natural that a subject so vital to a community as its transportation system should not be lost sight of completely, and from time to time sporadic attempts have been made both by the officials of the city and by other citizens, to bring the matter to a conclusion.

Exhaustive studies of the transportation problem together with recommendations based upon these studies have been made by this office and embodied in two reports. One, concerned principally with street railway service, was referred to in last year's annual report; the other, dealing with the subject of rapid transit, will be discussed later.

The new City Charter which is to go into effect in 1932, retains the statement of policy that the city shall ultimately acquire its public utilities, but unlike the present Charter, qualifies this requirement with the expression "when public interest and necessity demand." Of course, it goes without saying that this qualification is but common sense, as no policy should ever be adopted which is contrary to public interest and necessity. These certainly demand a unified and coordinated transportation system, but whether under municipal guidance or that of a private corporation, would appear to be the issue under the new Charter. Already there appear to be signs of an effort to discredit the Municipal Railway and magnify the virtues of corporate ownership.

While these sentiments appear on the surface to be genuine, they are found on investigation to be engendered by a corporation clique and a noisy few who are trying to nullify the progress made by our city toward solution of the problem.

Under the new Charter the control of the railways is vested in the Public Utilities Commission and it is doubtful whether any serious attempt to grapple with the problem should be made until this Commission is functioning.

Charter Amendment No. 35:

Under the strong urge of the street railway corporation the people on November 4, 1930, by a vote of 81,777 to 66,188, approved Charter Amendment No. 35, which had been submitted by Initiative. The principal provisions of this amendment are briefly outlined below:

Within twelve months after the amendment becomes effective, any street railway corporation in San Francisco may surrender to the City all previous franchises, and thereupon shall automatically receive in

lieu of such franchises, an operating permit for a term of twenty-five years from the date of filing the declaration of surrender.

All terms and conditions, except period of duration, of the franchises existing as of February 15, 1929, are retained.

The City has the right at any time to acquire the operative railway property of the company upon paying the fair value therefor; this value to be determined by mutual agreement, or if failing to agree, by any other manner provided by law.

Extensions may be made under supplemental permits, which shall expire concurrently with the permits granted upon the filing of the declaration of surrender.

No railway line shall be abandoned without authorization by ordinance of the Board of Supervisors.

By approving the amendment the people of San Francisco surrendered a distinct trading advantage in any negotiations for the acquisition of the private systems. This is a sharp setback to the accomplishment of a unified municipal system, and in the light of subsequent events, with a new charter providing for a change in the administration of the affairs of the City's utilities, it seems that the electors have shown undue haste in relinquishing the strategic position they held.

However, it cannot be denied, that when the proposition was submitted to the voters, the railway situation appeared to be at a stalemate, with no prospect of early action, and as a protest against allowing the matter to remain at a standstill many votes were cast in its favor. Also, many were induced to look on Charter Amendment No. 35 as a magic wand, which the Market Street Railway had but to wave to fill the city with new railway lines and perfect service.

Nevertheless, it is doubtless true that the adoption of the amendment, disposing as it does, of the question of expiring franchises, has removed the principal obstacle against improvement of the properties of the private corporations. And it is also true that the Market Street Railway has shown commendable promptness in starting its promised program of extension and improvement. But it is no less true, that the real big problem of coordination, on which improved service mainly depends, has been made more difficult. Also, it is not altogether evident how, under present conditions of fares and revenues, the financing of any extensive improvements can be justified.

The franchises granted under the ordinances listed below were excluded from the provisions of the amendment:

Ordinance No.	Date of Expiration	Routes Affected
288	Oct. 17, 1932	Junipero Serra and Sloat Boulevards. Nineteenth Avenue from Sloat Boulevard to Wawona Street.
425	May 12, 1933	Wawona Street from Nineteenth Avenue to Twentieth Avenue. Twentieth Avenue from Wawona Street to Lincoln Way.
1196	June 14, 1935	Gough Street from McAllister Street to Market Street.
1460	Jan. 23, 1936	Parnassus Avenue from Third Avenue to Judah Street. Judah Street from Parnassus Avenue to Ninth Avenue. Ninth Avenue from Judah Street to Pacheco Street.
1532	Nov. 28, 1929	Howard Street from Steuart Street to Twenty-sixth Street.
1890	Dec. 27, 1936	Post Street from Market Street to Leavenworth Street.

The first four ordinances listed above provide that at the expiration of the franchise, the roadway, track, and stationary fixtures upon the public streets shall become the property of the city. Those covering Howard and Post Streets were excluded to facilitate the proposed abandonment of the tracks thereon.

Condition of the Street Railway Industry:

This office, at the request of the Public Utilities Committee of the Board of Supervisors, has made extensive studies of financial and operating conditions throughout the country. These studies have shown no satisfactory way of increasing the railway returns in San Francisco. It is common knowledge that in all parts of the country the street railway business is suffering. In spite of the inadequate San Francisco five cent fare, the street railways of this city are in much better financial condition than many roads in the country which, although they have had large fare increases and have used many expedients to reduce operating costs, yet find their affairs going from bad to worse.

The question whether fare increases produce more revenue or have the opposite effect, appears to be one to which a definite answer is difficult. Even among those who have experimented with changes in fare, there can scarcely be said to exist complete unanimity of views. The predominant opinion is that in general, an increase in fares produces larger revenue, in spite of a decrease in passengers that generally follows a raise in fare. In analyzing the experience of any particular system, many conditions, both general and local, must be considered. It has been contended, and apparently with justification, that in many instances the decrease in travel after an increase in fare, is but a continuation of a general downward trend in travel, which through various causes, had started some time before the fare increase was put into effect. It is no doubt true that such a decrease

would be augmented after a raise in fare by a certain number of former riders, who through resentment, refuse for a time to patronize the railway. The severe industrial depression which we are now experiencing has had a most pronounced effect in decreasing railway revenues. The effect has been less marked in San Francisco than in most Eastern cities.

Rapid Transit:

As announced in the report of last year, a study of this important subject was undertaken. The work has been completed, and a comprehensive report, now in the hands of the printer, will soon be available. For this reason no extensive discussion of the matter will be attempted here, but the recommendations, quoted from the closing pages of the report, are given below.

"It takes a period of years to design and construct a subway, but before any of this work can be started, the routes and the financial plan must receive approval. Controversies over these fundamental questions have produced costly delays in other cities and San Francisco should profit by their example. With a view toward orderly procedure, the following recommendations are submitted for immediate consideration:

- "1. That approval be given to the plan submitted herein for an initial subway system in which surface cars are to be operated, comprising:

- (a) A four track subway on Market Street from McAllister Street to Sansome Street with a double track extension forming a loop at Battery Street.

- (b) A double track extension of the Market Street subway from McAllister Street westerly to a point between Franklin and Valencia Streets.

- (c) A double track branch subway leading out of Market Street, into McAllister Street and terminating between Leavenworth and Hyde Streets.

- (d) A double track branch subway running out of Market Street into O'Farrell Street and continuing to a point between Hyde and Larkin Streets.

- (e) A double track surface line on Market Street from Valencia Street to Sutter Street to replace the present four tracks.

- "2. That negotiations be carried on toward unification of the Market Street Railway, the California Street Cable Railroad and the Municipal Railway, in order to pave the way for future city wide rapid transit service operated in conjunction with surface feeder lines and suburban connections to the Peninsula and East Bay.
- "3. That immediate relief for rush hour traffic congestion be obtained by the abolition of parking between the hours of 7:00 a. m. and 10:00 a. m. and 3:00 p. m. and 6:00 p. m. on the streets north of Howard, south of Bush, east of Ninth Street and Larkin Street, with extensions on Mission Street to Twelfth Street, Market Street to Valencia, McAllister, O'Farrell, Geary and Sutter Streets to Van Ness Avenue.
- "4. That the peak of rush hour traffic, both morning and evening, be reduced through arranging for staggered hours of downtown employees.

- "5. That officials of the Municipal Railway and the Market Street Railway be requested to co-operate in improving downtown traffic conditions by such rerouting as will relieve Market Street of unnecessary cars.
- "6. That legislation be developed and passed providing an equitable procedure under which not less than 50 per cent of the cost of improvements such as the proposed subway could be assessed against the property benefited.
- "7. That authority be granted for the making of preliminary plans and estimates for the cost of cutting new streets through the long blocks south of Market Street and that \$5,000 be appropriated for this work.
- "8. That authority be granted for the collection of sub-surface data over the routes proposed for the subways and that for this purpose the sum of \$25,000 should be made available for expenditure during succeeding years.
- "9. That His Honor the Mayor appoint a Committee of representative citizens interested in the downtown traffic, with a view to having them familiarize themselves with the views presented in this report and to secure the co-operation of property owners and organizations in order to develop a public sentiment favorable to the construction of the subway herein proposed under the method of financing recommended.
- "10. That copies of this report be officially furnished to all of the public service corporations and others using sub-surface space, with the request that they gradually rearrange their facilities so that the construction of the subway could be executed with the least possible expense and inconvenience to the utilities and property owners."

Market Street Railway:

Reconstruction:

Two important reconstruction jobs completed by the Market Street Railway Company during the past year were Sutter Street from Stockton Street to Van Ness Avenue, and Market Street from McAllister to Haigh Street. These lines, both of them carrying heavy traffic, were in deteriorated condition and should have been reconstructed several years before. The Sutter Street tracks had been previously reconstructed in 1906, and those on Market Street in 1907 and 1909, so that their ages at the time of renewal were approximately twenty-five and twenty-three years, respectively.

As in all such work, the problem of maintaining traffic is of first importance, and on Market Street it presented particular difficulties. The Company arranged with the Municipal Railway to use the tracks of the latter during certain hours, leaving their own free for the reconstruction work. This plan, which had been worked out on mutually satisfactory terms, was, at the beginning, strenuously opposed by persistent agitators. However, after much discussion the folly of so hampering the work was realized, and on February 16, 1931, the Board of Supervisors adopted Resolution No. 33953, granting the desired permission to the Company. The arrangement, in effect from May 11 to June 6, 1931, inclusive, materially facilitated the work which, scheduled for forty working days, was actually completed in

twenty-five. Any inconvenience to patrons of the Municipal Railway was more than offset by this obvious convenience to the general public. Furthermore, the Municipal Railway, at no very distant date, will be confronted with a similar problem of reconstructing its own tracks on Market Street, and having shown a reasonable spirit of co-operation in the past, it can with better grace request a favor from the Company.

Balboa Street Line:

Following the procedure established by Charter Amendment No. 35, the Railway Company, under date of March 10, 1931, petitioned the board of Supervisors for a permit to construct a new street railway line into the Richmond District via Turk and Balboa Streets. This extension would connect with the Company's present tracks at Turk and Divisadero Streets, and run to a terminus on Balboa Street between Thirtieth and Thirty-first Avenues. The required permit was granted by Ordinance No. 9012, approved June 24, 1931.

This line is one which the Municipal Railway at one time proposed to construct, but the bond issues to provide the funds for this as well as other proposed improvements, failed of public approval. The patrons for this line will be drawn largely from the Municipal Railway's Geary Street lines and the Company's Fulton Street lines.

Abandonments:

The line on Tenth Street, between Market and Bryant Streets, is one whose abandonment the City Engineer had recommended in the 1929 report on the city's transportation requirements. It had not been receiving enough patronage to justify its continuance, and when, during the past year, the section of the Tenth Street sewer between Harrison and Market Streets was completed the street pavement was replaced without the tracks. The sewer from Harrison Street southerly had been constructed under a previous contract, and at that time the tracks from Harrison to Bryant Street were reconstructed in their original location. They still remain, but are non-operative and isolated.

Other abandonments which are being considered, but which have not yet been effected, are the tracks on Post Street and on Howard Street. These tracks were specifically excluded from the operating permit granted under Charter Amendment No. 35 so that there would be no obstacle to their removal on the part of the railway.

Municipal Railway:

Operating Costs:

While unit operating costs for the past fiscal year are a little over one-tenth of one per cent higher than for the preceding year, the ratio between revenue and operating expenses has reached 93.59 per cent, an increase of between three and four per cent. This means that aside from small incidental and irregular revenues, after direct operating expenses have

been paid, there remains out of each dollar of revenue, something less than six and one-half cents to apply on fixed charges. Depreciation and accident reserves, interest, and bond redemption for the year should approximate \$700,000, a little over twenty per cent of the passenger revenue. Thus it can be seen that each dollar of passenger revenue falls short of providing for all of the railway's financial needs by about fourteen cents. That the increase in the operating ratio over last year is not due to increased operating expenses may be seen by comparing the figures in the following tables, which are repeated from last year's report, and brought up to date. These data show the steady decline in revenue, which still continues. The figures for this year are derived from a preliminary statement which is subject to an audit and may be changed slightly before being issued officially.

Economy Meters:

Recently, it was determined to equip the Municipal cars with individual watt hour meters for the purpose of registering and economizing in power consumption. The "economy" meter selected for this use, manufactured by the Sangamo Electric Company of Springfield, Illinois, is furnished and installed at a cost of \$95 each. Since a tryout of test equipment in July, 1930, meters have been placed in most of the large cars and the installation is nearly completed. It is not planned to so equip the small, center-entrance cars.

Each motorman is being carefully instructed in methods of economy, through coasting, anticipating stops, particularly at signals, and careful operation generally. The different elements of handling the cars are at the same time stressed in the following scale of importance:

First—Safety.

Second—Maintenance of schedules.

Third—Economy of power.

The results so far seem to indicate that an appreciable saving in power may be expected, and it will be interesting to observe the effect of the installations during the coming year. Better operating methods will also produce savings in the maintenance of equipment through the elimination of unnecessary brake shoe and wheel wear.

Equipment:

Five new buses, purchased from Fageol Motor Company, were placed in service during the year. The first three, which cost \$25,897.50, including a turn-in allowance on three old buses, were delivered and put into service on July 21, 1930. The other two, placed in service on May 25, 1931, cost \$17,000, including a turn-in allowance on one old bus.

No new street cars were purchased during the year.

Carbarns and Shops:

No progress was made during the year toward the acquisition of these additional facilities, the need of which has been pointed out and emphasized in preceding annual reports. Needless to say the situation has not improved with the passing of the years.

Railroad Commission Study:

By Ordinance No. 9005, approved June 9, 1931, the Board of Supervisors directed the Board of Public Works to request the California Railroad Commission to make an investigation and report on the operation of the Municipal Railway. This report is to include "a study of traffic characteristics, schedules, financial results of operation, and financial and physical requirements for the immediate future; these studies to include possible operating economies, re-routings, and all other matters looking toward improvement in return, with a maintenance of adequate service and the retention of existing wage schedules and present basic rate of fare. That said study, report and investigation shall not embrace the formation of plans for consolidation or joint operation of the Municipal Railway with privately owned railways, except where incidentally necessary to effect economies, improve service or relieve street congestion."

It is expected that the preparation of this report will be well under way during the latter part of July, 1931.

Five Cent Fare Charter Amendment:

Proposed Charter Amendment No. 36, establishing five cents as the maximum fare to be charged on the Municipal Railway was presented as a referendum ordinance under the provision of the Charter which permits such ordinance to be proposed by "one-third of the Supervisors." This was submitted to the voters at the election of November 4, 1930, but was defeated. This legislation was ill advised and unnecessary.

Reconstruction:

In addition to the ordinary routing maintenance, a considerable amount of reconstruction work was done during the past year. The greater part of this was on the Union Street Line, which contains the oldest trackage of the system. A tabular summary of the more important jobs is given below.

MUNICIPAL RAILWAY OF SAN FRANCISCO
Statement of Principal Track Reconstruction Performed
During Fiscal Year Ending June 30, 1931.

Job. No.	Date Completed	Description	Total Cost
1096	Oct. 31, 1930	Track reconstruction, Baker St. between Greenwich and Union, 522' Double Track. Cable track removed and roadbed and track built.	\$13,018.01
1098	Dec. 31, 1930	Replacement of approximately 600 lin. ft. of double track in Presidio Reservation.	7,343.33
1099	Dec. 31, 1930	Reconstruction of track on Union St. between east line of Pierce St. and center line of Divisadero Street, approximately 1030 lin. ft. of double track. Cable track removed and standard roadbed and track built.	25,056.67
1111	Apr. 30, 1931	Reconstruction of track in Fort Mason—350' single track.	2,761.58
1121	June 30, 1931	Reconstruction of tracks on Columbus Ave. from Union to Green Sts. 310' double track. Rail and paving only.	5,739.81

COMPARATIVE ANNUAL STATISTICS, MUNICIPAL RAILWAY

	Dec. 31, 1914	June 30, 1929	June 30, 1930	June 30, 1931
Miles of single track.....	37.24	83.62	83.62	83.62
Miles of bus routes (round trip)		19.46	21.92	21.92
Number of passenger cars owned	197	234	234	234
Number of buses owned.....		18	18	18
Funded debt.....	\$5,459,800.00	\$2,902,000.00	\$2,802,000.00	\$2,603,000.00
Cost of road and equipment.....	\$4,980,177.69	\$9,380,218.88	\$9,451,203.22	\$9,529,767.24
Car miles operated.....	3,282,012	9,903,754	10,186,213	10,114,999
Total passengers carried.....	27,933,049	85,683,664	87,673,608	85,250,762
Passenger revenue.....	\$1,150,236.89	\$3,482,133.05	\$3,553,592.00	\$3,409,103.00
Operating expenses	\$ 613,939.32	\$3,118,241.64	\$3,209,157.85	\$3,190,482.34
Operating ratio	0.5338	0.8955	0.9031	0.9359
Interest on funded debt.....	\$ 122,642.08	\$ 149,039.33	\$ 139,673.83	\$ 130,218.34
Provision for depreciation.....	\$ 208,698.84	\$ 263,823.68	\$ 281,406.60	\$ 283,536.12
(Included with				
Provision for accidents.....Depreciation)		\$ 87,053.33	\$ 89,224.43	\$ 85,929.44
Platform expense.....	\$ 291,606.70	\$1,650,207.30	\$1,693,366.10	\$1,674,101.00
Platform exp. per car mile.....	\$ 0.0888	\$ 0.1666	\$ 0.1662	\$ 0.1659

OPERATING STATISTICS PER CAR MILE

	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922
Passengers carried.....	7,474	8,511	8,149	7,531	6,815	8,972	8,273	8,918	9,234	9,228
Passenger revenue.....	\$.3419	.3505	.3290	.3099	.2765	.3408	.3315	.3642	.3805	.3757
Way and structures.....	\$.0044	.0067	.0082	.0064	.0096	.0071	.0088	.0138	.0133	.0147
Equipment.....	\$.0081	.0147	.0131	.0122	.0131	.0138	.0204	.0252	.0267	.0282
Power.....	\$.0437	.0420	.0406	.0406	.0398	.0410	.0455	.0470	.0533	.0499
Conducting transportation.....	\$.0963	.1076	.1138	.1151	.1122	.1298	.1450	.1743	.1745	.1725
Traffic.....	\$.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0000
General and Miscellaneous.....	\$.0064	.0160	.0106	.0089	.0070	.0098	.0106	.0127	.0129	.0153
Transportation for Investment.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total Operating Expenses.....	\$.1590	.1871	.1863	.1832	.1817	.2015	.2303	.2731	.2808	.2805
Operating ratio.....	.4650	.5338	.5662	.5910	.6572	.5914	.6947	.7497	.7380	.7469
Platform expense.....	\$.0765	.0888	.0947	.0944	.0914	.1043	.1175	.1432	.1423	.1404
Passengers carried.....	.....	9,036	8,953	8,980	8,964	8,872	8,807	8,651	8,671	8,428
Passenger revenue.....	.....	.3674	.3657	.3673	.3651	.3604	.3584	.3516	.3489	.3370
Way and structures.....	.....	.0134	.0133	.0129	.0145	.0154	.0161	.0150	.0153	.0180
Equipment.....	.....	.0266	.0216	.0222	.0215	.0225	.0247	.0231	.0233	.0228
Power.....	.....	.0521	.0537	.0523	.0526	.0518	.0514	.0546	.0561	.0551
Conducting transportation.....	.....	.1684	.1756	.1799	.1822	.1956	.1980	.2006	.1999	.1993
Traffic.....	.....	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
General and Miscellaneous.....	.....	.0220	.0194	.0187	.0200	.0201	.0218	.0218	.0208	.0207
Transportation for Investment.....	.....	.....	.....	.....	.....	.....	.....	* .0002	* .0004	* .0005
Total Operating Expenses.....	.....	\$ .2825	.2836	.2860	.2908	.3054	.3120	.3149	.3150	.3154
Operating ratio.....	.....	.7689	.7754	.7785	.7966	.8475	.8702	.8955	.9031	.9359
Platform expense.....	.....	\$ .1387	.1463	.1498	.1520	.1636	.1645	.1666	.1662	.1655

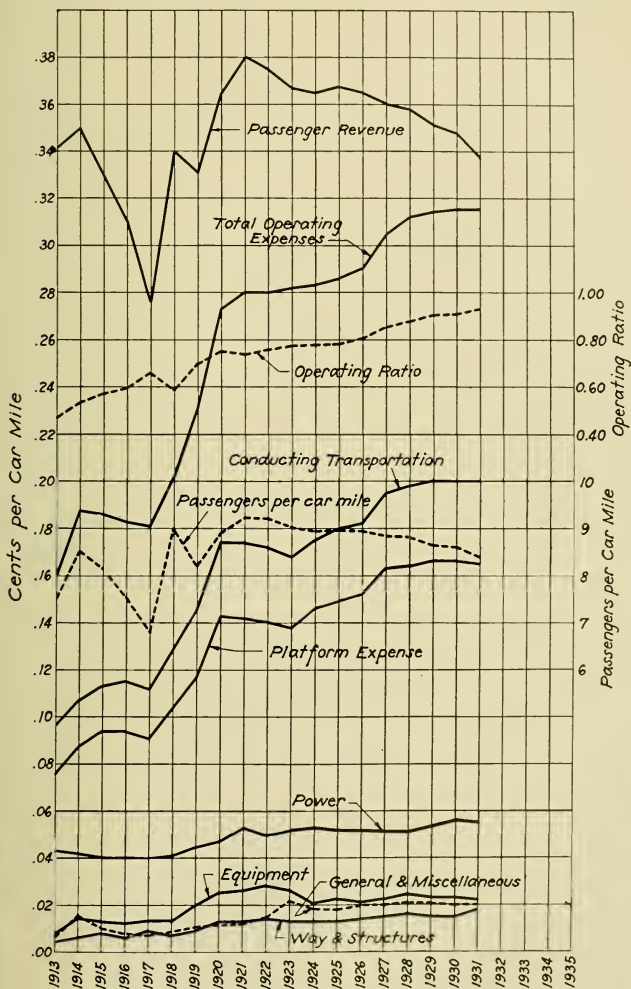
*Credit.

Years 1913-1914 end December 31st; other years June 30th.

COMPARATIVE OPERATING EXPENSES, YEAR ENDED DECEMBER 31, 1930

	PER CAR MILE			Key Sys. Transit	PER CAR HOUR			
	Mun. Ry. of S. F.	Market St. Ry.	Los Angeles Railway		Mun. Ry. of S. F.	Market St. Ry.	Los Angeles Railway	
Way and structures.....	\$.0163	\$.0216	\$.0208	\$.0283	\$.1582	\$.1982	\$.2186	\$.2810
Equipment .....	.0208	.0208	.0419	.0382	.2016	.1913	.4381	.3790
Power .....	.0598	.0527	.0318	.0478	.5779	.4839	.3329	.4747
Conducting transportation.....	.2031	.1488	.1623	.1473	1.9647	1.3653	1.6998	1.4627
Traffic .....		.0019	.0009	.0006	.....	.0178	.0096	.0064
General and miscellaneous.....	.0197	.0292	.0378	.0561	.1905	.2675	.3961	.5570
Transportation for Investment....	.0005	.0001	.....	.0008	.0048	.0011	.....	.0075
(Credit)								
Sub total	\$.3192	\$.2749	\$.2955	\$.3175	\$3.0881	\$2.5229	\$3.0951	\$3.1533
Injuries and damages.....	.0099	.0118	.0178	.0194	.0958	.1083	.1866	.1933
Depreciation .....	.0268	.0197	.0520	.0402	.2593	.1806	.5445	.3989
GRAND TOTAL	\$.3559	\$.3064	\$.3653	\$.3771	\$3.4432	\$2.8118	\$3.8262	\$3.7455

NOTE: Above tabulation based on reports of Companies to California Railroad Commission. Key System Transit operated to August 6, 1930, after which properties were operated by four different companies. Above includes combined operation by Key System Transit and other companies after reorganization. Bus operation not included where it was possible to eliminate it.



OPERATING STATISTICS-MUNICIPAL RY.

CURRENT CONTRACT DATA, 1930-1931
Applying to City Pay Contracts and Major Contracts Involving City Funds

Description	Contractor	Awarded	Completed Date	Completed %	Contract Amount	Expended to 6/30/31	Fund
Boulevards, Paving, Grading, Etc.							
Alemaný Blvd., Sec. C, Cont. 9, Ocean Ave. to San Jose Ave., Grading	Granfield, Farrar & Carlin	4/28/30	10/ 1/30	100	\$21,881.00	\$21,881.00	Boulevard Bonds
Alemaný Blvd., Sec. E, Cont. 20, Sagamore St. and Orizaba St. Intersection	Clarence B. Eaton	5/14/30	4/17/31	100	9,697.27	9,697.27	Boulevard Bonds
Alemaný Blvd., Sec. A, Cont. 16, Bay Shore Blvd. to Mission St. Paving	H. V. Tucker Co.	11/21/30	5 /5/31	100	(39,500.00)	39,500.00	Boulevard Bonds
Bay Shore Blvd., Sec. C, Cont. 29, Key Ave. to Third St, Paving	Pacific States Const. Co.	5/13/31		0	(28,167.25)		Boulevard Bonds
Great Highway—Lower Road, Ulloa St. to Lincoln Way	Federal Const. Co.	1/10/30	1/ 5/31	100	105,023.25	105,023.25	Boulevard Bonds
Junipero Serra Blvd., Cont. 13, Sloat Blvd. to the County Line	Eaton & Smith	3/25/29	6/11/30	100	419,816.49	419,816.49	Boulevard Bonds
Junipero Serra Blvd. Extension, Cont. 1, County Line to School St.	J. P. Holland, Inc.	9/23/29	5/31/30	100	128,349.67	128,349.67	Joint Highway Dist. No. 10
19th Ave. Extension, Cont. 14, Sloat Blvd. to Worcester Ave.	Eaton & Smith	2/25/29	11/12/30	100	268,244.99	268,244.99	Boulevard Bonds
Bernal Cut, Cont. 1. Bridges— Grading and Paving	MacDonald & Kahn, Inc.	10/ 3/28	5/28/30	100	616,814.16	616,814.16	Bernal Cut Bonds
Grade Change—Paving Ulloa St., 35th to 38th Aves.	Clarence B. Eaton	8/ 8/30		100	21,566.09	20,000.00	Boulevard Bonds
Sunset Blvd., Sec. B, Santiago St. to Yorba St.	Meyer Rosenberg	9/10/30		98	(92,000.00)	69,000.00	Boulevard Bonds
Sunset Blvd., Sec. C, Noriega St. to Santiago St.	California Const. Co.	10/ 8/30		92	(103,000.00)	72,000.00	Boulevard Bonds
Sunset Blvd., Sec. D, Noriega St. to Irving St.	California Const. Co.	9/24/30		99	(106,000.00)	73,500.00	Boulevard Bonds
Utah St. bet. 18th and 19th Sts.	Fay Improve. Co.	5/14/30	1/ 9/31	100	20,873.42	*10,000.00	County Road

CURRENT CONTRACT DATA, 1930-1931
Applying to City Pay Contracts and Major Contracts Involving City Funds

Description	Contractor	Awarded	Completed Date	%	Contract Amount	Expended to 6/30/31	Fund
Boulevards, Paving, Grading, Etc. (Continued)							
Harrison St. bet. 2nd and 3rd Sts.	Fay Improve. Co.	5/28/30		50	\$ (64,757.62)	*\$12,300.00	County Road
Corbett Ave. bet. Clayton St. and 24th St.	Meyer Rosenberg	4/14/30	12/24/30	100	64,740.25	*27,941.69	County Road
Golden Gate Heights, Cont. 1. Paving	California Const. Co.	12/10/30		40	(45,081.00)	*10,500.00	County Road
Montgomery St., Union to Greenwich St., also Alta St.	Chas. L. Harney	1/28/31		50	(54,063.90)	* 9,900.00	County Road
36th Ave., Vicente to Sloat Blvd., westerly one-half. Paving	Fay Improve. Co.	4/24/31		45	(11,002.69)	3,900.00	Boulevard Bonds
37th Ave., Vicente St. to Wawona St., easterly one-half. Paving	Fay Improve. Co.	4/24/31		45	(3,984.60)	1,800.00	Boulevard Bonds
36th Ave., Judah to Noriega St., westerly one-half. Paving	R. W. Telfer	4/24/31		0	(14,820.63)		Boulevard Bonds
Van Ness Ave. Extension, Mission to Howard Sts.	Hanrahan Co.	6/24/31		0	(36,893.80)		Boulevard Bonds
Carolina St., 22nd and 23rd Sts. Grading, Sewers and Walls	E. J. Treacy	4/ 8/31			(20,387.00)		County Road
Sewers							
Alenamy Storm Drain, Sec. B, Cont. No. 1	Eaton & Smith	10/16/29	5/27/31	100	273,535.30	273,535.30	Sewer Bonds
Alenamy Storm Drain, Sec. C	Healy-Tibbitts Const. Co.	9/10/30		100	120,789.86	119,000.00	Sewer Bonds
Alenamy Storm Drain, Sec. D	Clarence B. Eaton	9/10/30		100	38,412.35	37,000.00	Sewer Bonds
College Hill Tunnel Sewer (Sec. K—North Pt. Main)	T. E. Connolly	9/24/30		36	(251,617.00)	53,250.00	Sewer Bonds
15th St. Sewer, Sec. A, Harrison St. to Howard St.	Louis J. Cohn	2/14/30	9/17/30	100	61,573.08	61,573.08	Sewer Bonds

CURRENT CONTRACT DATA, 1930-1931

Applying to City Pay Contracts and Major Contracts Involving City Funds

Description	Contractor	Awarded	Completed Date	Completed %	Contract Amount	Expended to 6/30/31	Fund
Sewers (Continued)							
15th St. Sewer, Sec. B, Howard St. to 14th and Church Sts.	Healy-Tibbitts Const. Co.	4/ 8/31		19	\$ (113,680.50)		Sewer Bonds
Fillmore St. Sewer, Sec. B, 10th and Harrison Sts. to Fell St. and Van Ness Ave.	Louis J. Cohn	4/30/30	12/ 3/30	100	(115,000.00)	\$115,000.00	Sewer Bonds
Fillmore St. Sewer, Sec. C, Fell and Van Ness Ave. to Laguna and Grove Sts.	MacDonald & Kahn, Inc.	5/14/30	7/ 1/31	100	77,443.34	77,443.34	Sewer Bonds
Fillmore St. Sewer, Sec. D, La- guna and Grove Sts. to Turk and Steiner Sts.	MacDonald & Kahn, Inc.	5/23/30	2/11/31	100	98,218.55	98,218.55	Sewer Bonds
23rd Ave. and Geary St. Sewer, 23rd Ave. and Lake St. to Geary St. and 24th Ave.	Peter J. McHugh	4/30/30	6/ 3/31	100	78,364.78	78,364.78	Sewer Bonds
Ingalls St. and Bancroft Ave. Sewer	J. Varano	4/30/30	9/17/30	100	19,126.35	19,126.35	General Fund
Army St. Sewer, Pennsylvania Ave. to Mississippi St.	Louis J. Cohn	10/31/30	5/27/31	100	13,899.60	13,899.60	General Fund
Pierce and Baker Sts. Outfall Sewers	Louis J. Cohn	4/17/31		5	(13,673.00)		General Fund
Sunset Blvd. and Lincoln Way Sewer	Clarence B. Eaton	3/25/31		75	(40,050.00)	4,650.00	Boulevard Bonds
Alemanly Blvd., Sec. C, Cont. 24, Ocean Ave. to San Jose Ave. Drainage	J. Varano	10/31/30	1/ 9/31	100	21,699.14	21,699.14	Boulevard Bonds

CURRENT CONTRACT DATA, 1930-1931
Applying to City Pay Contracts and Major Contracts Involving City Funds

Description	Contractor	Awarded	Completed Date	Completed %	Contract Amount	Expended to 6/30/31	Fund
Miscellaneous							
Safety Zone Buttons, Cont. No. 2, Turning Buttons and Pedes- trian Lane Markers	E. J. Treacy	3/31/30		100	\$ (4,200.00)	\$ 3,150.00	General Fund
Safety Islands: Bay Shore Blvd. at Paul and Silver Aves.	R. Flatland	6/11/30	7/30/30	100	2,175.66	2,175.66	General Fund
Bay Shore Blvd. at County Line	G. A. Love Sons	2/14/30	9/17/30	100	648.00	648.00	General Fund
Safety Zone Beacons: Market and Laguna Sts., etc.	R. Flatland	5/23/30	7/23/30	100	1,376.00	1,376.00	General Fund
Castro, 17th and Market Sts., Street Traffic Improvement	Harry R. Love	7/23/30	1/14/31	100	797.84	797.84	County Road
Arterial Stop Signs, Cont. No. 1	R. Flatland	5/ 6/29		100	(9,900.00)	9,750.00	General Fund
Street Signs, Cont. No. 10	M. J. Lynch	9/26/30	1/21/31	100	2,016.00	2,016.00	General Fund
Garbage Incinerator—Test Piles	Healy-Tibbitts Const. Co.	6/11/30	9/ 3/30	100	2,920.00	2,920.00	General Fund
Alta Plaza Sidewalks	E. J. Treacy	4/14/30	6/25/30	100	4,399.28	4,399.28	County Road
Roosevelt Way at Henry St., Stairway, etc.	Chas. L. Harney	8/30/30	12/24/30	100	1,629.45	1,629.45	County Road
Stockton St. Tunnel, Water- proofing, Painting, Repairs	C. B. Sovig	3/ 7/30	10/29/30	100	13,972.00	13,972.00	County Road
Public Comfort Stations, Great Highway at Taraval and Judah Sts.	Clinton-Stephenson Const. Co.	1/10/30	10/ 1/30	100	50,396.44	50,396.44	Boulevard Bonds
Sunset Blvd., Water Supply System	E. J. Treacy	12/10/30	6/10/30	100	(27,108.57)	25,000.00	Boulevard Bonds
Grand View Ave., Sidewalks	E. J. Treacy	10/ 8/30	4/15/31	100	3,767.94	3,767.94	County Road
Sloat Blvd., Viaduct	Mission Conc. Co.	5/27/31		0	(115,433.44)		Boulevard Bonds

CURRENT CONTRACT DATA, 1930-1931
Applying to City Pay Contracts and Major Contracts Involving City Funds

Description	Contractor	Awarded	Completed Date	Completed %	Contract Amount	Expended to 6/30/31	Fund
Miscellaneous (Continued)							
Municipal Airport:							
Cont. No. 19, Additions to Hangar No. 2	Clinton Stephenson Const. Co., Ltd.	9/24/30	3/11/31	100	\$19,590.28	\$19,590.28	General Fund
Cont. No. 20, Boat Channel and Levee Repairs	Dutton Dredge Co., Ltd.	10/17/30	1/21/31	100	2,183.37	2,183.37	General Fund
Cont. No. 21, Pavement, Wearing Surface and Miscellaneous Work	Federal Const. Co.	11/14/30	3/11/31	100	5,384.56	5,384.56	General Fund
Cont. No. 22, Installation Elect. Centrifugal Pump	Byron-Jackson Co.	12/19/30	3/11/31	100	2,771.00	2,771.00	General Fund
Boulevard Lighting:							
Junipero Serra Blvd. and 19th Ave. Extension	Alta Elect. Co.	5/ 6/31		0	(14,940.00)		Boulevard Bonds
Portola Drive	Weidental Gosliner Elect. Works	5/ 6/31		5	(4,024.00)		Boulevard Bonds
Bernal Avenue	Butte Elect. & Mfg. Co.	3/27/31		0	(4,340.00)		Boulevard Bonds
Bay Shore Boulevard	R. Flatland	3/27/31		15	(21,520.00)	2,500.00	Boulevard Bonds
Great Highway—Lower Road and Laguna Honda Blvd.	R. Flatland	4/17/31		15	(9,489.00)	1,200.00	Boulevard Bonds
Municipal Railway							
Automobile Buses, No. 164	Fageol Motors Co.	5/ 5/30	7/24/30	100	25,897.50	25,897.50	Municipal Ry.

•Contract amounts are based on estimated amounts.

HETCH HETCHY WATER SUPPLY

Progress and Development

During the fiscal year 1930-31, noteworthy progress was made on the Hetch Hetchy Project.

In the mountains, several miles of trail were constructed to satisfy the requirements of the Raker Act. The entire trail work necessary was not completed but the construction will be continued during the summer and fall of this year. Bids were received on July 8, 1931, for permanent paving of the road from Mather to Hetch Hetchy so that this work also may be completed before winter.

Operation of the power system continued satisfactorily with the power revenue to July 31, 1931, aggregating \$14,377,948.03. Conditions for the coming season are not very encouraging due to the scant rainfall for 1930-31.

Construction of the San Joaquin Pipe Line will begin as soon as the contractor completes organization of his plant and it is expected that the line will be ready for service by June, 1932.

Progress in driving the Coast Range Tunnels was given a severe setback following an unfortunate explosion in the tunnel in July, 1930, in which 12 men lost their lives. Safety methods now in effect have reduced the speed of tunnel driving to one-half mile per month in 12 headings, as against one mile per month in 14 headings that was just being attained at the time of the accident. Nevertheless, at the end of the fiscal year, 19.8 miles of tunnel had been driven, nearly 7 miles of it during the past 12 months. Excavation of the 4½ mile section of tunnel from Tesla Portal to Thomas Shaft was completed in March, 1931, and placing of concrete lining there has just begun. About 3½ miles of tunnel in the various headings have been lined with concrete by the gunite method.

A long series of years of scant rainfall, culminating in three seasons of excessively low runoff, has so depleted the amount of water stored in the reservoirs of the Water Department that extraordinary measures are planned to bring in Hetch Hetchy water in advance of the completion of the Coast Range Tunnels, which is scheduled for some time in 1933. This office is now studying the merits of alternative pipe lines through which it is proposed temporarily to by-pass the tunnel and to pump an emergency supply of Hetch Hetchy water over the Coast Range Mountains.

An emergency pipe line 12½ miles long, connecting the system of the East Bay Municipal Utility District to the city's pipes was constructed out of Hetch Hetchy funds, and is now bringing in 32 million gallons daily to furnish an adequate supply of water for the citizens of San Francisco.

Organization and Headquarters Work

The Hetch Hetchy construction and the operation of the power system continue under general supervision of the City Engineer with Chief Assistant Engineer L. T. McAfee in direct charge.

City Headquarters Office:

The city office designs all structures and prepares plans and specifications for all projected work, makes studies of all necessary projects, prepares maps and descriptions of all necessary lands and rights of way, keeps office records of all work under way, selects and purchases all equipment for work done by day labor employees, handles extensive correspondence, does a certain amount of publicity work, checks and passes for payment all bills and payrolls, and directs operation of the Hetch Hetchy electric power system.

All of the above mentioned civil and mechanical engineering design and studies and all right of way mapping and descriptions are under direct charge of L. W. Stocker, assisted by R. L. Allin and staff of assistant engineers and draftsmen. General office work, bills, payrolls and purchasing are done by H. W. Kephart. Publicity is by L. B. Cheminant. Electrical design and immediate direction of power operation and other electrical matters are by P. J. Ost.

Some of the more important items of work handled by the office staff during the past year are mentioned below:

Designs, studies and most of the detail plans of the Red Mountain Bar Siphon and appurtenant structures were completed during the fiscal year. At the close of the year specifications for the construction of this siphon were being prepared.

The decision to rush the construction of the San Joaquin Pipe Line necessitated concentration of almost the entire office force on this work in preparatory studies followed by preparation of plans and specifications. This work was well done and required a large amount of overtime work by every member of the staff in studying the relative values of alternative routes. An outline of the major features of this work follows:

- Economic studies of sizes and thicknesses of pipe.

- Studies and plans of the San Joaquin River Crossing to be used in connection with applications for permits from the War Department and the State Reclamation Board.

- Economic studies, designs, and drawings of special structures at Oakdale and Tesla Portals.

- Studies and designs of steel bents for pipe supports.

- Studies of soil conditions in the San Joaquin Valley and methods of protecting the pipe against corrosion.

- Studies for location of the easterly eight miles of the pipe line.

- Designs and drawings of pipe joints.

- Designs and drawings of valve boxes, piers, railroad crossing culverts, and miscellaneous concrete structures.

- Preparation of maps, profiles, and right of way drawings.

- Writing and assembling specifications and preparing estimates of quantities.

During the fall of 1930, studies, estimates, and plans were prepared for the use of the Supervisors in their investigation of various plans for developing an additional supply of water to augment the depleted supply

from the San Francisco Water Department properties. Plans and specifications were prepared for the construction of the emergency pipe line connecting the East Bay Municipal Utility District system at San Lorenzo with the existing pipe lines of the San Francisco Water Department at Newark; the construction and certain office work on this pipe line were handled by the Water Department. The acquisition of rights of way was handled by this office.

Extensive research and study were done in the preparation of answers to about one hundred questions on Hetch Hetchy matters submitted in three groups by the Board of Supervisors at the instance of one of its members. These questions dealt with the finance, estimates, construction programs, and progress of the Hetch Hetchy Project and other matters.

The tunnel construction in the Coast Range Division required much office work on design, investigation, selection, and purchase of equipment, especially after the Mitchell accident, when permissible type locomotives were purchased to replace existing locomotives in all gassy headings and other major changes in equipment were made. Equipment for concreting the tunnel was also given consideration during the past year.

Work continued throughout the year on the design of lining to be placed in the Coast Range Tunnel. The tests to determine the intensity of pressure to be supported by the lining were continued throughout the year. Construction drawings of overflow shafts at the portals of the Coast Range Tunnel were completed.

Plans were prepared for pipe and incidental structures to replace certain decayed flumes in the Lower Cherry Aqueduct. The continued operation of this system is dependent upon these replacements and the revenue derived from the system is sufficient to warrant the expenditures for this purpose.

Under the agreement, hereafter mentioned, between the City and the Department of the Interior, the City is required to complete the Hetch Hetchy Reservoir trails and to place a permanent surface on the Mather-Hetch Hetchy road in the calendar year 1931. During the fiscal year 1930-1931 this office prepared plans and estimates for continuation of the trail construction inside Yosemite National Park and plans and specifications for contracting the road work in accordance with agreement made with Secretary Wilbur in Washington.

As the fiscal year closed, plans and estimates of cost were being prepared for an emergency pipe line over the Coast Range to bring Hetch Hetchy water into San Francisco prior to the completion of the Coast Range Tunnel. Two plans were being studied for delivery of 45 m.g.d. and 60 m.g.d. These studies were made in compliance with an ordinance of the Board of Supervisors. Descriptions of the alternate plans are given elsewhere in this report.

Work on the program for the establishment of permanent real estate records, described in the Annual Report for 1926-1927, pages 50 and 51, has been practically suspended during this year, due to pressure of other work.

Land descriptions were prepared for a condemnation suit to acquire 8.8 miles of pipe line right of way near the easterly end of the San Joaquin Pipe Line. Land descriptions, maps, and other data were prepared during the fiscal year for permits, franchises, and easements for constructing the San Joaquin pipe line across the San Joaquin River and Elliott Cut, under county roads and railroads, and through irrigation districts. Permits and agreements were prepared during the year in connection with the City's lands and rights of way in other divisions of the projects.

Contracts:

Plans and specifications were completed and contracts were let during the fiscal year 1930-1931 as follows:

Contract No. 122—for the construction of the Newark-San Lorenzo Pipe Line.

Contract No. 123—for the construction of the San Joaquin Pipe Line.

Plans and specifications were prepared for Contract No. 124, for grading and surfacing the Mather-Hetch Hetchy Road. Bids will be received for this work on July 8, 1931.

Plans and specifications were being prepared at the close of the fiscal year for the following work:

Contract No. 124—for hauling cement, sand and gravel in the Coast Range Division.

Contract No. 125—for furnishing and delivering butterfly and relief valves for the San Joaquin Pipe Line.

Contract No.—for the construction of the Red Mountain Bar Siphon.

On September 10, 1930, final payment in the amount of \$50,000 was made on Contract No. 77-C for the construction of aqueduct tunnels in the Mountain Division on a cost-plus-fee basis. The Contractor's acceptance of this payment marks the final adjustment of this contract after co-operation of the City Attorney, and ends a long-continued controversy between the city and the Contractor.

Actual construction work on the following contracts has been completed but formal acceptance has not been made pending the settlement of disputed points, all of a minor nature:

Contract No. 113-E—for driving tunnels in the Brown Section of the Foothill Division.

Contract No. 121 —for furnishing and delivering a portable gravel plant for the Coast Range Division.

Contract No. 122 —for the construction of the Newark-San Lorenzo Pipe Line.

Appended to this report is a table of detail data on current contracts for the year 1930-1931.

The purchasing department handled purchases of miscellaneous materials, supplies, etc., aggregating \$2,108,442.09, and payments for lands, etc.

amounting to \$4,634.08, during the fiscal year. The latter figure does not include payments for lands and rights of way for Newark-San Lorenzo Pipe Line, which amounted to \$27,613.90.

Field Headquarters:

Construction operations on the Coast Range Tunnel continue from Livermore Headquarters under direct supervision of C. R. Rankin, Construction Engineer. Accounting work for the entire Hetch Hetchy system is carried on at the same office, under direct charge of Willis O'Brien, Chief Accountant and Auditor.

Construction of the San Joaquin Pipe Line has necessitated establishment of a local headquarters office at Tracy. The pipe line work is under direct charge of L. A. McAtee, Construction Engineer.

Operation of the Hetch Hetchy Power System is carried on from headquarters at Moccasin, under direct charge of Thornton Easler, Assistant Electrical Engineer. Construction of trails above Hetch Hetchy Reservoir is directed from this office, as also will be the paving of the road from Mather to Hetch Hetchy.

Field Employees:

With increase of work on the Coast Range Tunnels and opening up of work on the San Joaquin Pipe Line, the number of employees on the project has begun to increase. The following tabulation shows the total number of employees, including field headquarters and engineering forces, as of June 30, 1930, and June 30, 1931:

	June 30, 1931		June 30, 1931	
	Construc- tion	Oper. and Maintenance	Construc- tion	Oper. and Maintenance
Lake Eleanor Reservoir.....	—	1	—	1
O'Shaughnessy Dam.....	—	2	—	2
Lower Cherry Power System.....	—	7	—	7
Early Intake Diversion Works.....	—	1	—	1
Priest Reservoir.....	—	1	—	1
Moccasin Headworks.....	—	1	—	1
Moccasin Penstocks.....	—	1	—	1
Moccasin Power House.....	—	25	—	25
Moccasin Reservoir.....	—	2	—	1
Moccasin Transmission Line.....	—	6	—	1
Foothill Division Aqueduct.....	—	3	—	2
San Joaquin Pipe Line.....	—	—	18	—
Coast Range Tunnel.....	1349	—	1433	—
General and Miscellaneous.....	61	7	52	8
Totals	1410	57	1503	51
Total, construction and operation—	1467		1554	

Medical Service:

For many years the City has maintained a hospital equipped to handle all cases, both medical and industrial. Until May, 1930, this hospital was at Groveland, Tuolumne County. Shortly prior to that date, a new hospital was built at Livermore on a site secured from the Livermore Sanitarium,

in accordance with an agreement under which the latter will acquire the hospital building, upon stated terms, at the completion of the city's work. The city's Livermore hospital was opened for service on August 25, 1930.

The main hospital building is 187 ft. by 41 ft. and contains 31 beds and full equipment, the greater part of which was taken from the former hospital at Groveland. The hospital staff is housed in three cottages which were erected for that purpose.

Ambulance service is provided, subject to call day or night, for transportation between the eight camps and the hospital.

All employees are subject to physical examination at the hospital before entering the service of the city. The doctor and staff of eight assistants are subject to call at all times. Dr. John P. Degnan continues as Chief Medical Officer in charge of the hospital.

The record of cases treated at the hospital from its opening on August 25, 1930, to June 30, 1931, follows:

Non-hospital cases.....	1580
Hospital cases, City Employees.....	711
Hospital cases, outside pay patients.....	94
<hr/>	
Total hospital cases.....	805
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Total cases treated.....	2385
Capital operations.....	56

Average time in hospital for hospital cases, 13 days.



LIVERMORE HOSPITAL

Relations with United States Department of the Interior:

The program to be followed by the City to comply with the provisions of the Raker Act as to road and trail construction and land conveyance, was officially established during a conference between a committee of City Officials and the Secretary of the Interior and officials of the National Park Service. The committee representing the City consisted of three members of the Board of Supervisors, the City Engineer, and the City Attorney. They were assisted in Washington by the senators and representatives from California.

The conference was held in Washington, D. C., during the first week of December, 1930, primarily to clarify the power disposal situation following the defeat of bond issues for the acquisition of the distributing systems of the Pacific Gas and Electric Company and the Great Western Power Company in the election held August 26, 1930. It had been suggested that the agency contract now in force for the distribution of Hetch Hetchy power through the Pacific Gas and Electric Company's system was in conflict with provisions of the Raker Act and should be revoked. To abrogate this contract and deprive San Francisco of the revenue derived from power sales would cause an increase in the tax rate of at least twenty-seven cents per year. The committee requested that the Secretary permit continuance of the present agency contract until the City should be financially in a better position to undertake the purchase and operation of its own distributing system, and presented in detail a proposed program for road and trail construction and land conveyances. The Secretary has indicated his approval of the committee's proposal.

Summarized briefly, the program calls for road and trail construction in the year 1931 at an estimated cost of \$250,000, and annual payments to the United States in the amount of \$250,000 each for the five years 1932 to 1936 inclusive, this money to be used toward construction of specified roads as described below. The total expenditure to complete the program will then be about \$1,500,000.

Accomplishment of this program will complete the city's compliance with all of the provisions of the Raker Act applying to construction of roads and trails. The status of this program at present is as follows:

Land Conveyance:

The city has fully complied with the provisions of the Raker Act which require that the City convey to the United States all lands lying in Yosemite National Park and in Stanislaus National Forest adjacent to the Park boundary and owned by the City prior to the adoption of the Raker Act and not required by the City for construction and other purposes. To date such conveyances total 1698 acres of land.

The Yosemite National Park boundary as changed by Congressional Act of May 9, 1930, now includes a city-owned tract of 160 acres from which most of the timber has been logged. The Crane Flat road proposed to be

built by the National Park Service will traverse this tract. A form of deed to convey this and the adjoining 160-acre tract to the United States has been prepared and will soon be transmitted to the Secretary of the Interior.

Hetch Hetchy Reservoir Trails:

The program outlined by the committee mentioned above provides:

"That the City will complete the construction of a trail on the north side of the Hetch Hetchy reservoir site and to the Tiltill Valley and to Lake Vernon, according to the plans heretofore presented to and approved by the Secretary of the Interior, said work to be performed by the City, to be completed within the calendar year 1931."

During the fiscal year 1930-1931 a trail on the north side of Hetch Hetchy Reservoir from Lake Eleanor Road to Rancheria Creek and from Rancheria Creek to Tiltill Valley, a total length of eight miles, was constructed. The Secretary approved the location and specifications for this section of trail on April 23, 1930.

Detail surveys were completed during the fall of 1930 for the trails from Tiltill Valley to Lake Vernon and from the constructed trail near Rancheria Creek easterly to a junction with the existing Pleasant Valley trail of the National Park Service. Plans and specifications for these trails received the approval of the Secretary of the Interior on April 1, 1931. Construction was undertaken by City forces immediately on appropriation of funds for this work by the Board of Supervisors on June 30, 1931.

Mather-Hetch Hetchy Road:

The City has agreed with the Department of the Interior to "place upon the existing road from Mather to the Hetch Hetchy reservoir, a bituminous or asphaltic wearing surface, making such curvature changes as may be necessary for the safety of said road, and will also construct where necessary in the opinion of the Secretary, guard walls of stone. The approximate cost of said work to be two hundred thousand dollars, the same to be performed by the City to the satisfaction of the Secretary, and to be completed within the calendar year 1931."

In the spring of 1931 a survey was made of the existing road to determine the extent and amount of work necessary to bring its condition up to the standards required by the Department of the Interior. The plans and specifications for grading and surfacing were made in conformity with National Park Service standards and were reviewed and approved by Park Service officials. Bids will be received on this contract on July 8, 1931. The contract time is set at one hundred fifty calendar days so that unless weather conditions prove unusually severe, the work will be completed during the year 1931.

Mather-White Wolf Road:

The City's program for this road contemplates—

"That for the purpose of complying with its obligations to construct a road along the southerly slope of Smith's Peak from Mather past Harden Lake to a junction with the old Tioga Road, the City will,

during the month of July, 1932, and thereafter during the month of July, 1933, and during the month of July, 1934, pay to the United States of America, through the Department of the Interior, the sum of \$250,000 during each of said months, which said sums will be applied and used by the Department of the Interior for the purpose of constructing the aforesaid road, which said road will have an average surface width of 16 ft., and to be constructed in accordance with plans approved by the Secretary of the Interior. That the payment of the said sum of seven hundred and fifty thousand dollars by the City will be considered as the fulfillment of the City's obligations under the Raker Act to construct said road."

No activity has been taken by the City during the past fiscal year in connection with this road. Financial advances were made by the City to the United States Bureau of Public Roads for surveys of this road, as mentioned in previous Annual Reports.

Lake Eleanor Road:

The Secretary of the Interior some years ago, in accordance with his interpretation of a provision of the Raker Act, demanded that the City build a road from Hetch Hetchy Reservoir to Lake Eleanor via McGill Meadow so as to render the road available for motor travel. It is particularly gratifying that the controversy which arose out of this demand has been settled at the conference in Washington by the City agreeing to advance money for the construction of the proposed Crane Flat-Mather Road in lieu of building a new Lake Eleanor road.

The agreement on this point runs as follows:

"The City will, upon the demand of the Secretary of the Interior, made upon the City between the first day of January and the first day of April, 1934, pay to the United States, the further sum of \$500,000, which said sum shall be used for the construction of a road of similar character to that mentioned above, and which said road shall connect with and lead from the Mather-Harden Lake Road to Crane Flat. The said sum of \$500,000 shall be payable in two equal installments of \$250,000 each, one payable July 15, 1935, and the other payable on July 15, 1936. That it is understood that this road is not specifically mentioned in the Raker Act and that in consideration of the payment of said sum of \$500,000 the Secretary of the Interior will accept the road which has been heretofore constructed by the City from Hetch Hetchy reservoir site to Lake Eleanor via McGill Meadow, as and for the road or trail provided in the Raker Act to be so constructed by the City, and as a compliance by the City with the provisions of said Act requiring the construction of said road."

The omission of any new Lake Eleanor road from the construction program was advocated by the City Engineer and City Health Officer, as it provides for better control in the future of sanitation on the City's watershed.

Publicity:

The magnitude of the Hetch Hetchy Project cannot be appreciated by the average layman except by actual visit to the work. Many people visit

O'Shaughnessy Dam and listen to the description of the City's work that is given by an employee stationed there during the summer months for that purpose.

At Moccasin Power House there is a visitors' gallery from which one may look at the four immense generators. The village at Moccasin is colorful, neat, and clean, and a view of it well repays one for a short detour off the main Big Oak Flat Road.

During a political year such as now, the citizens' minds are warped by articles in the noisier newspapers, published to further the policies of those papers, which refer disparagingly to the work in general. In these papers a miner's scratched finger is a serious accident; if eight men out of eighty see fit to gorge themselves on fresh fruit and ice water and become sick, these papers have "Hetch Hetchy Miners Poisoned." To counteract such misstatements and exaggeration, this department puts before the public occasional statements and pamphlets. In the rotunda of the City Hall is a relief map or model of the project. An assistant engineer is present each day from 2:30 to 3:00 p. m. to explain the project. Two reels of motion pictures portraying the construction and the finished work are available for display at clubs, associations, etc. The projection of these pictures is accompanied by a lecture describing and discussing the entire project.

Inspection Trips:

The annual inspection trip of the Grand Jury over the Hetch Hetchy work was made on June 5, 6, and 7, 1931. They made a careful examination of the work, both under construction and completed.

Their report states that the magnitude of the work cannot be appreciated by one who has not seen it, that the tunnel operations are being carried on in a thoroughly efficient and highly satisfactory manner; that the type of labor is high, the morale excellent, and that the camps are modern and sanitary; that the City Engineer's determination to prosecute the tunnel work by day labor is correct and results in a saving to the City; that operation of the Moccasin Power System is ideal; that the determination of the Supervisors to rush the construction of the emergency pipe line over Altamont Pass is premature; and that any such construction undertaken should be of the most economical and temporary character. The report was signed by the ten members of the Grand Jury who made the trip.

The annual inspection trip of the Supervisors took place over the following week-end, from June 13 to 17 inclusive. The party consisted of about 25 persons, including 8 Supervisors.

Hetch Hetchy Railroad:

Operation of the power system necessitates maintenance of the Hetch Hetchy Railroad in condition satisfactory for operation of light, gasoline-driven equipment. During the winter the highways in the upper part of the Mountain Division are impassable for days at a time. In such cases use is

made of the railroad, which is kept clear by a snow plow pushed by gasoline locomotive.

One steam locomotive and several cars are still kept but are not operated.

Power System

Operation:

Operation of the power houses at Moccasin and Early Intake continued throughout the year. The total output was diminished due to the scant precipitation which has been state-wide. During the past season the rainfall at elevations up to 5,000 ft. was approximately 75 per cent of normal. At the higher elevations the snowfall was less than for the season of 1923-24 when the runoff of the Tuolumne River drainage area was 28 per cent of normal. For the season 1930-31, the runoff was approximately 44 per cent of normal, which is a much better yield than for most of the watersheds in California.

The reservoir storage from the season 1929-30 was sufficient to continue normal power generation until early January, 1931. At that time the output was reduced to what could be generated by the flow of the river, which is always small in winter. Shortly after the middle of March, 1931, the stream flow increased sufficiently to allow the plant to go to full output.

Lake Eleanor filled to its capacity of 28,000 acre feet, but Hetch Hetchy with 206,000 acre feet capacity, reached its maximum storage on June 10, 1931, with 127,000 acre feet, a portion of which belonged to Turlock and Modesto Irrigation Districts. To protect the farmers and supply them the amount of irrigation that they needed, water was released from Hetch Hetchy and Lake Eleanor in volumes greater than could be utilized in the generation of power. The power revenue will therefore be seriously curtailed this coming year unless we are favored with unusually heavy, early rains.

The following tabulations illustrate the hydrographic conditions:

Hetch Hetchy Runoff:

Average for 21 years.....	685,876 acre ft. — 100%
Maximum, Season 1910-11.....	1,233,000 acre ft. — 180%
Minimum, Season 1923-24.....	266,583 acre ft. — 39%
Present, Season 1930-31.....	300,000 acre ft. — 44%

Rainfall:

	Hetch Hetchy		Lake Eleanor	
	Inches	%	Inches	%
Normal	31.74	100	38.53	100
Season 1929-30.....	25.81	81	29.13	76
Season 1930-31.....	23.55	74	29.99	78

The following tables give the details of the amount of energy generated, its disposition, and the income from power sales annually since the beginning of power operation:

HETCH HETCHY POWER REVENUE Preliminary Statement, Subject to Adjustment

Year	City Use	Misc. Consumers	P. G. & E.	Total	City Use	Misc. Consumers	P. G. & E.	Total	Combined Revenue
1918	\$ 3,358.55	\$ 2.04	\$ 24,888.10	\$ 28,248.69	\$ 183.43		\$ 858,621.88	\$ 858,805.31	\$ 28,248.69
1919	22,857.74	6.60	68,245.00	91,109.34	14,328.57		2,281,769.88	2,296,098.45	91,109.34
1920	40,251.76	16.44	79,373.04	119,641.24	75,585.55	\$ 173.13	2,314,745.66	2,390,504.34	119,641.24
1921	100,873.29	24.65	38,040.00	138,937.94	71,571.20	269.01	2,266,955.45	2,338,795.66	138,937.94
1922	154,476.80	78.46	17,250.00	171,805.26	66,703.30	233.81	1,995,136.49	2,062,073.60	171,805.26
1923	136,724.10	127.01	38,980.00	175,831.11	103,863.73	104.63	2,055,902.66	2,159,871.02	175,831.11
1924	65,665.54	20.93	51,370.00	117,056.47	88,774.48	109.08	1,008,019.66	1,096,903.22	117,056.47
1925	24,513.20	37.92	65,175.00	89,726.12					117,056.47
1926	680.00		38,635.00	39,315.00					948,531.43
1927	114.35	285.46	58,615.00	59,014.81					2,335,413.45
1928	59.50	372.84	49,230.00	49,662.34					2,449,519.15
1929	252.90	448.71	23,285.00	23,986.61					2,388,458.00
1930	130.60	539.54	39,540.00	40,210.14					2,086,060.21
1931 (7 mos.)		396.36	29,955.00	30,351.36					2,290,081.16
Totals	\$549,958.33	\$2,356.96	\$622,581.14	\$1,174,896.43	\$421,010.26	\$ 889.66	\$12,781,151.68	\$13,203,051.60	\$14,377,948.03
	Total—Early Intake.....				549,958.33	2,356.96	622,581.14	1,174,896.43	
	Total—Both Stations.....				\$970,968.59	\$3,246.62	\$13,403,732.82	\$14,377,948.03	

—Compiled by M. M. O'Shaughnessy, City Engineer.
September 14, 1931.

Generation and Disposition of Electrical Energy

	1929-1930 kw.-hrs.	1930-1931 kw.-hrs.
Generated by Moccasin Power House.....	479,856,750	465,518,000
Generated by Early Intake Power House.....	10,592,000	8,706,800
Received from P. G. & E. Co.....	1,000	1,000
Total Energy.....	490,449,750	474,225,800
Consigned to P. G. & E. Co., Newark.....	424,546,000	400,136,000
Delivered to P. G. & E. Co., Tuolumne.....	7,801,000	6,380,000
Used at Power Houses.....	1,088,900	1,106,000
Used on Mountain Division.....	240,600	240,000
Used on Foothill Division.....	1,645,002	155,950
Used on Coast Range Division.....	15,669,500	28,919,900
Losses and Unaccounted for.....	39,458,748	37,388,950
Total Energy.....	490,449,750	474,225,800

Construction work on the Coast Range Division during the year showed a very marked increase in the amount of power used. This is due largely to the installation and operation of large capacity blowers in the tunnels. Completion of work on the Foothill Division resulted in great reduction in power consumed on that Division. The heavy increase in use of power by the City on the Coast Range Tunnel work and the curtailment of output due to shortage of water during the winter are reflected in the amount generated and consigned to the Pacific Gas and Electric Company at Newark.

Maintenance:

On the Moccasin system there has been no noteworthy maintenance work during the past year other than the continuation of the work of installing vibration dampers on high voltage transmission line conductors. These dampers consist of cast iron weights attached by clamps to the conductors. They are so located as to effectually damp out vibration waves and prevent crystallization of the aluminum conductor which might in time result in the breaking of the wires. The work is carried on while the conductors are under a potential of from 110,000 to 120,000 volts. Through the ingenuity of the City's employees and particularly H. A. Crowley, Patrolman at Livermore, it has been possible to install the dampers without de-energizing the line which generally could be done only on about two Sundays in a month. Careful attention to detail has made the work go faster and more safely than if the dampers had been put on with the line de-energized. This work is now about 90% complete. The method of work has been followed with great interest by the major power companies, one of which sent fifteen men on one day to view it.

The Early Intake wooden storage flume has reached the end of its useful life and will have to be replaced during the coming year. A small force of carpenters was kept at the Early Intake Plant during the winter of 1930-1931, making repairs and minor replacements constantly so as to keep the flume in service.

A number of improvements of a minor nature but of lasting benefit have been made at the Diversion Dam on Tuolumne River at Early Intake and also at Lake Eleanor and O'Shaughnessy Dams.

The Mountain Division Tunnel from Early Intake to Priest Reservoir was inspected on January 18, 1931 and found to be in very good condition except for slight erosion of the concrete invert at some points. Some roughening of the invert is noticeable since the previous inspection made in December, 1928.

Municipal Distribution of Power:

The annual report for 1929-1930 contains an extensive discussion of municipal distribution of power, with summaries of reports presented to the Supervisors by the City Engineer. On the day of the State primary election, August 26, 1930, four power propositions authorizing bond issues totaling \$68,115,000 were submitted to the voters. Following is the record of votes cast on these propositions:

	For	Against
1. Purchase of P. G. & E. Distribution System.....	24,930	61,974
2. Purchase of Great W. P. Co. Distribution System.....	24,894	62,343
3. Extend power line to San Francisco.....	25,255	59,961
4. Build Red Mountain Bar Power House.....	25,425	59,525

The fourth proposition, which received a slightly more favorable response than the others, is a matter still worthy of considerable discussion. The estimated cost of a generating plant at Red Mountain Bar is \$1,045,000. The power generated at this plant, if sold under the same arrangements as that generated at Moccasin Power House, would produce a revenue of \$500,000 annually, or in other words, would meet all charges and pay for itself in three years.

The low cost of this development is due to the fact that the main aqueduct work is completed and the main power transmission line, with capacity sufficient for the additional output from this plant, passes directly by the site.

The value of the plant is indicated by the voluntary proposal of the valley irrigation districts that they finance and build the power plant, operate it for five years, and then release it, free of cost, to the city.

Storage Reservoirs:

Operation of outlet gates, weather observations, and other duties require the services of one man at Lake Eleanor. At O'Shaughnessy Dam (Hetch Hetchy Reservoir) two men, a keeper and his assistant, are stationed.

Although besieged with requests, this office refuses to issue any permits for traveling over the Lake Eleanor road or for fishing. This is in accordance with my mature consideration, the request of the Board of Health, and agreement with the Secretary of the Interior.

Emergency Construction to Avert Water Shortage

Before San Francisco could proceed with construction of dams at Lake Eleanor and Hetch Hetchy, it was necessary to get permission from the Federal Government, as both of these sources lie within Yosemite National Park. This permission was granted by Congress in what is known as the Raker Act which was signed by President Wilson on December 19, 1913.

Opponents of the City's undertaking succeeded in having written into the bill the following stipulation:

"That the said grantee" (San Francisco) "shall not divert beyond the limits of the San Joaquin Valley any more of the waters from the Tuolumne Watershed than, together with the waters which it now has or may hereafter acquire, shall be necessary for its beneficial use for domestic and other municipal purposes."

This stipulation precluded any possibility of bringing the mountain water to San Francisco as long as the city's needs could be met by the yield from the Spring Valley Water Company's system. Based on the San Francisco rainfall records since 1849 this yield has always without question been accepted by hydraulic engineers to be 60 to 65 m. g. d. although engineers for the Company have from time to time estimated a much greater yield. The present consumption of water from this system averages 52 m. g. d. and increases probably 3% annually. It is evident that with normal rainfall conditions the system should produce ample water for our needs. It was estimated, very conservatively, that the yield of the system would be sufficient until 1932, so it was decided to time the Hetch Hetchy construction for completion in that year. Actually, due to various unlooked for delays, it will be completed in 1933.

The water situation has become extremely acute, due to deficient rainfall during the last few years. The reservoirs of the Water Department taken over from the old Spring Valley Water Company now hold but three months' supply, the lowest amount of storage on record.

In the fall of 1930 it became evident that an emergency supply of water must be introduced to avoid shortage. Assuming normal rainfall for the winter of 1930-31 it was estimated that 20 m. g. d. additional should be brought in without delay. Prior to the City's acquisition of the local system, the Water Company's engineers had considered two alternative sources for an emergency supply. One of these was a pumping station on the San Joaquin River near Tracy, with a pipe line 22 miles in length to carry water over Altamont Pass whence it would flow in natural stream channels or pipe about 20 miles to Sunol, to be there taken into the Company's aqueduct. The other was a 12½ mile cross-connection pipe and a pumping station, taking water from the system of the East Bay Municipal Utility District at San Lorenzo and delivering it to the pipe line at Newark.

This latter construction was preferable in all respects and in October, 1930, an agreement was entered into between the City and the East Bay District that allowed the work to proceed. Money for construction was

provided from Hetch Hetchy bond funds to the extent of \$1,096,000 and specifications were prepared in this office.

The Newark-San Lorenzo Emergency Pipe Line consists of 35,000 ft. of 44 in. by 5/16 in., and 32,000 ft. of 36 in. by 1/4 in., welded steel pipe. The pump station was first planned for delivery of 20 m. g. d. but later was enlarged to double that capacity. Bids for making and laying the pipe were received October 29, 1930 and the pipe line was completed on February 21, 1931. Lack of rainfall during the winter made necessary the increase in pump capacity. At present the city is obtaining 32 m. g. d. through this pipe line. The purchase price of the water is four cents per 100 cu. ft. (5.33 cents per 1000 gallons).

A further emergency supply was obtained by sinking wells on Forty-fourth Avenue in the sub-surface sands in the Sunset District, a procedure advocated many years ago by the City Engineer, but not adopted by the Water Company until shortly before the time when the City acquired the Company's system. Almost 6 million gallons daily are obtained from a series of 20 wells.

A third additional supply comes from the water encountered in driving the Coast Range Tunnel. About 4 million gallons daily from this source enter the system of the Water Department.

The combined yield from these emergency sources has reduced the draft from storage in the reservoirs to a very low figure. The completion of the Coast Range Tunnels cannot be expected before the end of 1933. If the drought of the last few years should extend into next winter, even the present completed emergency supplies would be inadequate. It has therefore been decided to rush additional emergency construction of the Hetch Hetchy aqueduct so as to deliver mountain water from Hetch Hetchy in San Francisco by June, 1932. The construction features necessary to do this, are the completion of the pipe at Red Mountain Bar in the Foothill Division, the San Joaquin Valley Pipe Line, a temporary pipe and pump system to bypass the Coast Range Tunnels, and a connection from the tunnel to the existing Bay Crossing Pipe Line.

Except for the weather emergency, the construction of the San Joaquin Pipe Line might well have been deferred for about a year, so that the pipe would be completed simultaneously with the tunnel, thus saving a year's depreciation and interest charges on the pipe line cost. As will be noted under "Aqueduct, San Joaquin Division," contract for this work has been let and the pipe line is due to be completed in June, 1932.

The Red Mountain Bar Siphon described under "Aqueduct, Foothill Division," must be completed to bring the water through the Foothill Tunnel to the San Joaquin. Plans and specifications are now being prepared and bids will be called for during the present year.

To bypass the Coast Range Tunnels until their completion in 1933 two alternative pipe and pumping routes are under consideration. One of these, called the Altamont route, would take off from the end of the San Joaquin Pipe Line at Tesla Portal, extend over Altamont Pass and through Liver-

more Valley, Pleasanton and Sunol to a connection with the 3.4 mile tunnel at the portal west of Alameda Creek, a total length of approximately 40 miles with a pumping lift of 440 ft.

The other route, called Corral Hollow line, would utilize 4.4 miles of completed tunnel from Tesla Portal to Thomas Shaft. A pumping station in the tunnel would lift the water 540 ft. through the shaft and thence about 6 miles up Corral Hollow to a second pump station which with a lift of 785 ft. would raise the water over the summit to flow by gravity to the west portal of the 3.4 mile tunnel at Alameda Creek. This line will be 23.6 miles long, with total pumping lift of 1325 ft.

The studies are still incomplete, but the Corral Hollow line will probably be the cheaper to construct and operate for a limited time. Either route will utilize the 3.4 miles of existing tunnel from Alameda Creek to Irvington Portal, of which about 400 ft. remain to be driven. This excavation should be completed in August, 1931, and the concrete lining may be placed before the completion of the San Joaquin Pipe. From Irvington Portal to the beginning of the constructed Bay Crossing Pipe Line, 7,000 ft. of 60 in. diameter pipe must be built as part of the permanent aqueduct to connect with the Dumbarton trans-bay pipe. About four months' time will be ample for this work.

The construction cost of the temporary installation, \$1,850,000 must be kept at a minimum as the pipe will be entirely superseded by the tunnel when completed in 1933. After that date the pipe may be maintained as a standby unit, or salvaged for use in other parts of the water system.

Aqueduct, Foothill Division

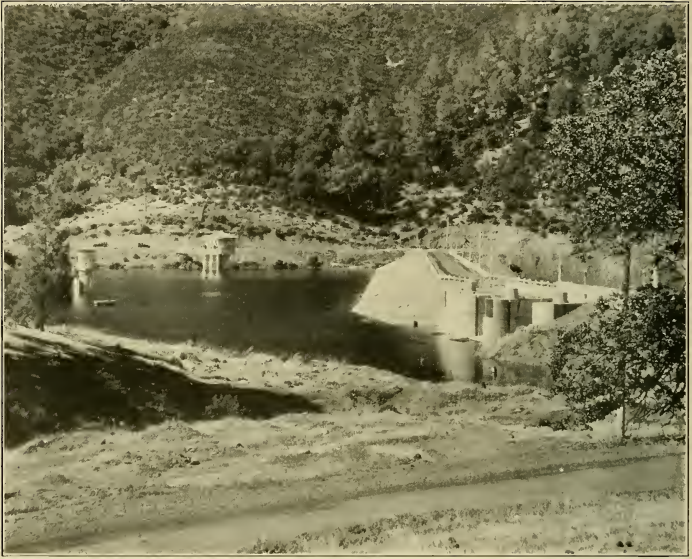
This division extends from the tail race of Moccasin Power House to the eastern edge of the San Joaquin Valley. The water, after leaving the power house, is caught in the Moccasin re-regulating reservoir, behind Moccasin Dam, to equalize the flow after disturbance of its constancy by power production, before delivery into the Foothill Tunnel.

Moccasin Re-regulating Reservoir:

The completion of Moccasin Dam and details of its construction were noted in last year's report. On November 7, 1930, the Department of the Interior approved the City's application map, filed under the Raker Act, granting 654 acres of additional land to the City for protective area for this reservoir. At present the reservoir is in service under substantially the conditions that will obtain when the aqueduct is complete. The water leaves the reservoir via the Foothill Tunnel through which it passes for 5.2 miles to Red Mountain Bar, where it wastes into Tuolumne River.

Red Mountain Bar Pipe:

The Foothill Tunnel meets the canyon of Tuolumne River at Red Mountain Bar. Inverted siphon pipe line 9½ ft. in diameter is used to cross under the river and up the opposite bank above the Don Pedro Reservoir high-water line, to the beginning of the next section of tunnel. In 1922 the City



MOCCASIN DAM

Spillway at right. Main outlet tower, beginning of Foothill Tunnel at left center.
Auxiliary outlet tower at left

constructed the 770 ft. length of this pipe that would be submerged by Don Pedro Reservoir. This pipe was laid in a trench which was blasted out of the bedrock of the river bottom, enveloped in concrete from 12 in. to 24 in. thick, and lined internally with concrete.

To connect the constructed pipe to the completed tunnel, it will be necessary to lay 918 ft. of pipe on the east side of the river and 826 ft. on the west. This pipe eventually will contain certain operating features such as main valve, Venturi meter and a branch outlet on the east side to the proposed Red Mountain Bar Power House. Provision is now being made for their installation at a future date. On the easterly canyon wall there will be a concrete sand trap; on the west side, at the tunnel inlet, there will be an overflow structure. This pipe line construction will be undertaken within the next few months and must be completed no later than the San Joaquin Pipe Line.

Red Mountain Bar Power Development:

From the mountain reservoirs the aqueduct to this point has a capacity in excess of 400 m. g. d. In the early years of operation of the aqueduct, a

much less amount than this will be carried through the aqueduct from this point to San Francisco. It is proposed to use the surplus amount to generate power and from studies made in this office, it develops that a 25,000 horse-power plant may be built at Red Mountain Bar for approximately \$1,000,000, which will generate power that will net \$400,000 annually if sold at the same wholesale rate that is now realized on the power from the Moccasin Plant. Although the electorate has not yet authorized the issuance of bonds for this construction, the plans for the pipe siphon have been made with the idea that the plant may be built in the future.

Aqueduct, San Joaquin Division

The San Joaquin Division of Hetch Hetchy Aqueduct extends from Oakdale Portal, the westerly terminus of the Foothill Tunnel to Tesla Portal, the beginning of the Coast Range Tunnel, a distance of 47.5 miles. Oakdale Portal is in Tuolumne County, about 4 miles southeast of Knights Ferry, at elevation 747 feet. Tesla Portal lies 7 miles south of Tracy in San Joaquin County, at elevation 399 ft. The route crosses Stanislaus County.

Eventually the Hetch Hetchy aqueduct across the valley will consist of three pipes 6 ft. or even greater in diameter, but initial construction of a 5 ft. pipe appears to be best from an economic standpoint.

As is noted elsewhere in this report, the time of construction of this unit was advanced about a year as a means of averting water shortage in San Francisco. The present contract calls for completion of the pipe line by June, 1932. At the present time the contractor is assembling equipment and actual construction will begin in a few days.

Surveys:

During the year, alternate survey lines were run over the easterly ten miles of the San Joaquin pipe division and studies were made to determine the most economical location. After final location had been determined, the line was staked out in the field for its entire length and a line of profile levels was run. A line of precise levels was also run over the division and permanent bench marks were established.

The located line crosses six railroads, many highways, county roads, and irrigation ditches. Detail surveys were made at each such intersection to furnish data for the design of the requisite crossing structures.

Test pits were dug to determine the character of the material to be excavated from the pipe trench, so that proper estimates might be made. A soil survey was made to assist in determining the kind of protection required for the pipe in the various kinds of soil.

All field work is handled from rented offices in Tracy and Oakdale.

Rights of Way:

The right of way is generally 110 ft. in width, but at the east end for nearly 10 miles it is 200 ft., and at the west end for nearly 3 miles, it is 150 ft.

The greater part of this right of way was acquired in fee several years

ago, when the Moccasin Power Transmission Line was being built and some when the Tesla Portal tract was bought. The City allows the former owners to continue using the surface of the land so long as it does not interfere with the power operations and aqueduct construction and operation.

The 9 miles of 200 ft. right of way westerly from Oakdale Portal were not bought at that time. Upon the rush decision to construct the San Joaquin Pipe Line, it was essential that the contractor be given immediate access to the work. Time was too short to undertake negotiation with the owners for purchase of the necessary lands so a suit in condemnation was filed by the City Attorney on June 16, 1931 in the Superior Court at Modesto. A writ of immediate possession was granted June 25, 1931, work began on the pipe trench shortly afterwards, and the lands are now being acquired and paid for.

For crossing San Joaquin River and Elliott Cut, both of which are classed as navigable streams, permits were obtained from the United States War Department, dated May 11, 1931 and from the State Reclamation Board, dated May 20, 1931.

For crossing county roads in San Joaquin County, no franchise was necessary. Stanislaus County on April 27, 1931, granted a franchise for road crossings.

Easements for several railroad crossings were granted by agreements as follows: Southern Pacific Company, June 1, 1931, covering two crossings; Central Pacific Railway Company, June 1, 1931; Tidewater Southern Railway Company, June 4, 1931; and Atchison, Topeka and Santa Fe Railway, July 15, 1924. An agreement with Sierra Railway of California is now being prepared.

All railroad crossings will be in concrete culverts which will be built either by the City or by the railroad, as may be agreed. Plans of culverts have been submitted to the various companies for approval.

The pipe line crosses four irrigation districts. Agreements have already been entered into with Oakdale and Modesto Irrigation Districts allowing the city to construct aqueducts and transmission lines across structures and rights of way of the Districts. In the Banta-Carbona Irrigation District the pipe line crosses no structures or rights of way of the District. One canal of West Stanislaus Irrigation District which is crossed was constructed under a permit from the City.

Pipe Contract:

Bids for furnishing and laying the pipe were received on May 20, 1931 and contract awarded May 22, 1931 to Youdall Construction Company in the estimated amount of \$4,136,479. The City will furnish various appurtenances and will also construct culverts under existing railroads. The line consists of $47\frac{1}{2}$ miles of welded steel pipe with diameter varying from 56 to 66 inches and thickness from $\frac{5}{16}$ to $\frac{1}{2}$ inch. The eight bids received ranged from the low bid up to \$5,379,470, with an average of \$4,717,699.94. The total amount of steel is about 40,000 tons and the unprecedentedly low

price is due to a spirited price war of steel manufacturers and an effort to keep steel mills operating, even though at a loss. Time of completion is one year. Bidders were allowed the option of riveted, lock bar, or welded pipe, and for a short section, concrete pipe, but all bids were for welded pipe. The longitudinal seam will be welded, but the Contractor will use his option to rivet the circumferential field joints.

The pipe line is to occupy part of the City's strip of land from 100 to 200 ft. in width owned in fee, upon the greater part of which one double circuit power transmission line is already in operation. In the future this strip will accommodate two additional pipe lines and one additional power line.

At the crossing of San Jacquin River and at Elliott Cut, the pipe will be depressed below stream bottom and will rest on concrete saddles supported by timber piling. It will be incased in a reinforced concrete jacket 6 inches thick and lined internally with cement plaster of minimum thickness of $1\frac{1}{2}$ inches. In the low, swampy areas adjacent to the river, the pipe will be in concrete saddles on timber piling.

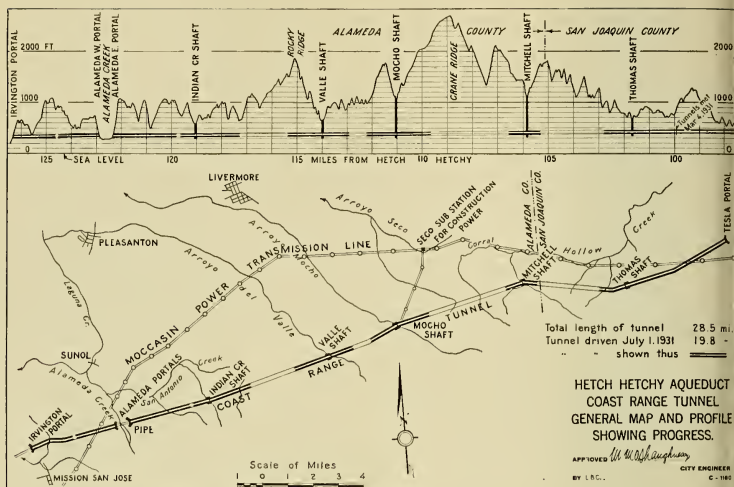
As a result of soil surveys, several different types of pipe protection are being used. All pipe will be dipped in an asphaltic coating which must have a final thickness of at least $1/16$ inch. In the dry, non-corrosive soil this will receive additional protection by being wrapped with 40 lb. asphalted felt. In slightly corrosive soils or in locations that although dry now may later, if placed under irrigation, develop corrosive properties, the felt wrapping is to be displaced by a one-half inch coating of 12 sack per yard cement mortar with wire mesh insertion. In the soggy land at and adjacent to the river crossing, an area that eventually may be submerged by the State Water Conservation plan, the concrete envelope will be 2 inches in thickness. In the rocky trench near Oakdale Portal, in addition to bedding the pipe and backfilling with fine material, the asphaltic coating will be protected from mechanical injury by using the one-half inch exterior concrete envelope.

At Oakdale Portal, the end of the Foothill Tunnel, the 10 ft. 3 in. diameter concrete conduit will terminate in a spherical, steel manifold with three 6 foot outlets, one for the present pipe and two for future additions.

Aqueduct, Coast Range Division

This division of the aqueduct extends from Tesla Portal, 7 miles south of Tracy, at elevation 399 ft., to Irvington Portal at elevation 316 ft., near Mission San Jose. The valley of Alameda Creek, which will be crossed by pipe line 0.6 mile in length, divides this tunnel into two sections, which are 25.1 miles and 3.4 miles long.

The 25 mile tunnel is worked from two portals and 5 shafts, being thus divided into 6 sections. One of these sections, from Tesla Portal to Thomas Shaft, a distance of 4.4 miles, was "holed through," (meaning that the excavation was completed) on March 4, 1931 and placing of concrete invert was immediately begun. The longest and most difficult section, that from



Mocho Shaft to Mitchell Shaft (5.2 miles), should be completed by the end of 1933.

Funds for construction of the Coast Range Tunnel were first requested by the City Engineer on December 14, 1925 when he submitted to the Supervisors for approval, a budget of expenditures for the Foothill Tunnel and for beginning work on the Coast Range Tunnel. Two months later the portion of the budget applying to the Foothill Tunnel was approved by the Supervisors, allowing that work to proceed, but they withheld approval of the items of Coast Range Tunnel work to again question the advisability of the tunnel location and construction which had been adopted as part of the Freeman Plan of 1912. The Coast Range Tunnel budget was again submitted to the Supervisors on October 24, 1926, with no result. In January, 1927 a report was submitted by Dr. W. F. Durand, noted hydraulic engineer of Stanford University, more recently consulting engineer on Hoover Dam, which substantiated the City Engineer's recommendation of tunnel construction rather than the discarded method of installing pipe and pumping over the mountain. On March 5, 1927 after a delay of 15 months from the time of the City Engineer's original request, the Supervisors approved the budget.

Work began immediately. Roads, camps, power and telephone lines were built, rights of way acquired and actual sinking of shafts began. Dur-

ing the fiscal year 1927-28, the aggregate depth of shafts sunk was 2245 feet. During the fiscal year 1928-29 the shafts were completed by sinking a total of 405 ft., 12 of the 14 tunnel faces were opened up, and 4.1 miles of tunnel driven. During the fiscal year 1929-30 although some of the headings were shut down pending sale of bonds to finance the work, the tunnels were advanced 8.5 miles to a total of 12.6 miles. In the month of June, 1930, almost one mile of tunnel was driven. In July, 1931, the work received a severe setback from an unforeseen gas explosion in which 12 men lost their lives. As a result of extra safety methods put into effect at about this time, and due also to holing through two headings, the annual progress for 1930-31 was 7.2 miles, the total to date being 19.8 miles or 70% of the tunnel length.

During the year, gunite concrete lining was placed in various locations in 2.5 miles of tunnel, making a total length of gunite concrete lining of 3.4 miles.

Detail figures of progress are shown in the following tabulations.

Coast Range Division—Length and Progress of Construction Units

Working Point		Total depth of shaft Feet	Dist. bet. working points Feet	Tunnel driven during yr. Feet	Tunnel driven to 6/30/31 Feet	Tunnel to be driven Feet	Gunite lining placed Feet
Tesla Portal.....	W			2,158	13,904	.....	.....
			23,311			.....
Thomas Shaft.....	E	348	.....	4,406	9,406	.....	1,479
	W		.....	2,201	6,166	.....	3,063
			22,174			13,223	
Mitchell Shaft.....	E	812	.....	1,850	2,786	.....	891
	W		.....	2,528	3,802	.....	1,729
			27,565			16,891	
Mocho Shaft.....	E	823	.....	2,233	6,872	.....	2,009
	W		.....	2,912	6,029	.....	366
			15,303			3,873	
Valle Shaft.....	E	376	.....	2,411	5,401	.....	86
	W		.....	2,748	7,468	.....	2,004
			26,873			10,222	
Indian Creek Shaft....	E	301	.....	3,389	9,182	.....	3,800
	W		.....	877	3,076	.....	814
			17,139			1,148	
Alameda E. Portal.....				3,540	12,916		1,294
Alameda W. Portal....				3,031	8,490		184
			18,192			717	
Irvington Portal.....	E			3,494	9,003	.....	.....
Total feet.....			150,557	37,778	104,501	46,074	17,719
Total miles.....			28.5	7.2	19.8	8.7	3.4

Tesla-Thomas boled through March 4, 1931.

Safety Work: Mine Rescue and First Aid:

During the sinking of Mocho Shaft in 1928, it early became evident that two objectionable gases, hydrogen sulphide and methane, would occasionally be encountered in the underground workings.

Hydrogen sulphide, as its name implies, is a combination of hydrogen and sulphur, with a pronounced odor similar to rotten eggs. It can be absorbed into the blood stream and produce a poisonous effect, such as temporary blindness. Fortunately, its presence is easily detected from its odor, and its influences are temporary, so that it seldom produces serious effects.

Methane is a combination of hydrogen and carbon. It is a colorless, odorless gas of considerably lighter weight than air. It is not poisonous but constitutes a hazard in mining operations on account of its inflammability. Small amounts of methane in the air are not dangerous, but a mixture of air with 5% to 15% of methane is highly explosive.

Two Wolf Safety Lamps for the detection of inflammable gases were installed at each heading and men were trained in their use. From time to time other safety equipment has been added, until at the present time there are available:

- 14 Union Carbide Company electric gas detectors.
 - 1 Carbon Monoxide detector.
 - 1 Bullard Inhalator with two extra breathing tanks and equipment for two patients.
- 33 "All Service" gas masks with 100 cannisters, each cannister being sufficient for 2 hours service. This is the only approved mask for use in carbon monoxide, with the exception of the oxygen breathing apparatus.
- 10 Gibbs 2 hour oxygen breathing apparatus with spare oxygen bottle for each machine.
- 1 Pump for recharging oxygen bottles.

Men trained in the use of this equipment are always on duty.

On June 8, 1930, an explosion due to methane in the upper Alameda Creek Tunnel of the old Spring Valley system which was being driven by the San Francisco Water Department, caused the death of 7 miners. Trained men from the Hetch Hetchy Coast Range Tunnel immediately took charge of the rescue and recovery work.

Mine rescue training began on June 21, 1930 under supervision of the United States Bureau of Mines. At first a picked personnel was trained but later on the work was extended to all camps. Practice training is being carried on continually and new men are constantly being trained. The Bureau has issued 175 certificates to men who have completed the training on Hetch Hetchy Mine Rescue.

The Industrial Accident Commission on July 14, 1930, called for our aid at the Glenn Mine in Placer County, where a number of men were trapped by fire. Five men were immediately dispatched from Livermore but they were



MINE RESCUE SQUÁD

turned back before reaching their destination as the rescue work in Placer County had already been accomplished.

A class in Advanced Mine Rescue Training for engineers, superintendents and fire bosses, was started October 5, 1930, by R. B. Currie of the United States Bureau of Mines and as a result some 60 men received certificates by the Bureau.

A class in First Aid was started March 9, 1931 by Mr. Currie. The first class consisted of 30 engineers, superintendents, timekeepers, fire bosses and others in authority. Subsequently these men conducted classes in the various camps and to date about 900 men have received certificates of completion of the course, from the United States Bureau of Mines.

Contests in this work are held from time to time between crews from different communities, and training is carried on continually. The California



CLASS IN FIRST AID TRAINING AT INDIAN CREEK CAMP

Safety Council on May 27, 1931, held an Intersectional First Aid Meet at the Palace Hotel in San Francisco. The two teams entered from the Hetch Hetchy Coast Range Division placed fourth and fifth out of eighteen teams entered. This is considered a most creditable showing as some of these men had been on the team only about two weeks and were in competition against veteran teams from other mining industries.

The chance of injury is much less for a man trained in first aid, as he has become "Safety conscious." The accident reduction record is stimulated also by the standing rule that each week each camp which does not have a man enter the hospital on account of injury is entitled to a special chicken dinner.

Upon beginning work on the Coast Range Tunnel, due consideration was given to the probability of encountering occasional pockets and seams that would discharge methane into the tunnel. The tunnel passes two miles south of the abandoned Tesla coal mines penetrating the Cretaceous series, where 34 years ago some trouble was experienced in mining from this cause. The gas almost always accompanies coal and oil deposits. In this case it develops from rocks of the Cretaceous period and seeps through formation cracks to enter the Franciscan series through which the tunnel is being driven.

After the first occurrence of methane in Mocho Shaft, 2 Wolf Safety Lamps were put in service at each heading. This lamp is a refinement of

the original Davy Safety Lamp. A flame burns at a wick in an atmosphere screened from the outside. If inflammable gas is encountered the height of the flame as seen through the clear globe, indicates the amount of dangerous gas. Shift bosses were entrusted with the custody and use of these lamps. The mucking machines transferred from completed tunnel work were converted from electric operation and were equipped with compressed air engines. Electric lighting of the tunnels was by vapor proof fittings, approved by the Bureau of Mines, with best type of portable electric cables, and with all work done by highly experienced men. The electric storage battery locomotives were the same ones used in the completed Mountain and Foothill tunnels where no explosion ever occurred.

After the Mitchell Shaft explosion rescue work was undertaken by the crews trained for that purpose. The fact that no member of the rescue crew suffered any injury in this difficult and hazardous assignment, speaks well for the thoroughness of their training.

Many investigations, including that of an Alameda County Jury, followed the accident. The fact was developed in the evidence before the Jury, that neither electric wires nor electric locomotives had caused the explosion. Both safety lamps were broken and in the clothes of two of the victims matches and smoking materials were found, this latter in violation of the safety rules.

The then Governor of California, Honorable C. C. Young, appointed a committee of five to investigate this and other disasters in underground workings of the State. One of the members was Chief Engineer of the Safety Division of the United States Bureau of Mines. This committee brought out the fact that for the seven year period from 1921 to 1927, mining fatalities in California averaged 5.22 per 1000 men employed, as against 4.55 for coal mining throughout the United States. They found also that on the Hetch Hetchy tunnel work for the same period, the average annual rate of fatalities per 1000 men employed was but 2.17 as against 3.25 for metal mining in the United States as a whole. These very creditable figures for Hetch Hetchy were not even quoted by the newspapers, which were utterly unfair in their references to the accident.

After the accident, work was suspended at the shaft camps until a new set of rules could be promulgated by the State Industrial Accident Commission and the United States Bureau of Mines. Occasionally these rules are amended as conditions or circumstances may warrant.

An entire readjustment of excavating equipment was determined. Serious delay resulted from the edict to discontinue use of the electric locomotives then in use and to substitute for them the "permissible" locomotives, as these latter had to be constructed—none had ever before been used on coast construction. Electric lights and wiring were discarded, and as a substitute therefor each man carries an individual electric cap lamp receiving power from a storage battery carried on his back or belt. This lighting is very unsatisfactory and resulted in many minor injuries to head, arms and feet. Blowers which had been discharging sweet, cool air from a 24 inch

pipe to the face of the tunnel where the men work, were ordered reversed and placed on suction, exhausting the foul air, thus carrying the fresh air down the shaft and through the full length of the tunnel to the face, and making the atmosphere warm and humid. Additional air is secured by an auxiliary blower which picks up the air back of the main blower intake and forces it to the face through a canvas pipe. Pumps are operated by compressed air except that under certain conditions "permissible" electric motors are used.

"Permissible" powder is used in blasting. Firing is done electrically by means of specially designed switches which permit the current on the wires for only a fraction of a second. All men are brought through tunnel and shaft to the surface at the time of shooting. To do this, the men from both headings from a shaft, must be transported thousands of feet through the tunnel and hoisted through the shaft with idle time costing so much per hour. This rule is subject to slight modification but entails much added expense on the project.

Fire bosses supplementing the foreman are constantly on duty, watching for indications of gas and prepared to take action if such is found. If methane is encountered in quantity greater than one-half of one per cent in the fresh air of the main tunnel, all men except such as are necessary to correct this condition are removed to the surface until the gas content is reduced to a safe percentage. The fire boss carries an appliance which indicates the amount of inflammable gas present in the air. The working principle utilizes the effect of combustion on the surface of a glowing non-catalytic filament whose electrical resistance varies with temperature and is measured by an electrical device calibrated to indicate the amount of inflammable gas present.

Magnetically locked flame safety lamps are used by shift bosses, who are required to make hourly tests for inflammable gas.

To prevent head and foot injuries and to minimize such injuries as cannot be prevented, the men are furnished "hardboiled" hats and hard toed boots.

At irregular intervals the men entering the underground workings are searched for matches and smokers' articles. Within the last six months a man was observed taking a surreptitious smoke in one of the tunnels. The shift boss went after him, but he left the tunnel and has not been seen since.

Some few exceptions to the general safety orders permit use of electric lights and ordinary motors in the shafts where there is absolute absence of methane and free circulation of air from the surface.

The application of the Safety Orders is administered by an Assistant Engineer for the city, an engineer of the Industrial Accident Commission, and an engineer of the United States Bureau of Mines.

The adoption of the safety measures required in addition to those previously provided, and a rigid adherence to their principles have resulted in delay in the program of tunnel construction estimated at one year, and the purchase of the permissible equipment and the slowing down of work have



FIREBOSS WITH SAFETY LAMP AND ELECTRICAL GAS DETECTOR

added to the cost of the work an amount that cannot be accurately stated but is probably about \$1,000,000.

Since the Mitchell accident there have been only three fatal accidents with an average number of men employed of 1238, or 2.18 per 1,000 men, the same rate as before, which, as already has been noted, is lower than the rate for metal mining in the United States.

Geological Studies of Tunnel Conditions:

The original geological studies upon which the tunnel location was based in 1916 were made by H. J. Packard, whose field work was under the supervision of Dr. J. C. Branner of Stanford University. The field observations were supplemented by diamond drill borings.

During tunnel construction the City's engineers have been aided by

Dr. Bailey Willis, as consulting geologist, who carries on surveys both on the surface and underground. As a result of these detail studies, in a few cases the line of tunnel has been slightly deflected to avoid bad ground and reach better rock for tunnel driving.

Livermore Headquarters, Shops and Yards:

In addition to the building enumerated in last year's report, an automobile machine shop, 30' x 72', of frame construction with galvanized, corrugated steel sheathing, has been constructed. This has released considerable additional space in the machine shop. Work done in the various shops has been increased to include overhauling and rebuilding of steel forms to be used in placing concrete lining in the tunnels.

The shops and yards at Livermore, served by two railroads and central to the greater part of the tunnel construction work, do much to facilitate the work by rapid and efficient handling of materials and maintenance work.

The yard at Sunol is the base for materials and supplies for the three westerly camps, Indian Creek, Alameda Portals, and Irvington. This yard also is served by two railroads and from it to the camps the roads are good and the haul is fairly short.

Surveys:

The usual precise surveys of alignment and levels have been carried on throughout the year. The main survey parties make periodical checks of the line and grade surveys made daily by the resident instrument men at the various camps. In swelling ground these check surveys are very necessary as the monuments often become displaced.

As an example of efficiency, the tunnels from Tesla Portal and Thomas Shaft, a distance of 23,311 ft. with two intervening angles, holed through on March 4, 1931, with a line difference of 1.79 ft., a grade difference of .015 ft., and a horizontal difference of 1.3 ft.

The survey organization has been very useful in securing quick results on projects brought forward in the Board of Supervisors. Crews from the Livermore organization have functioned well on these assignments.

Roads:

No new roads were built during the year, but maintenance work was done on all the existing roads. Additional gravel surfacing was done on the roads to Indian Creek, Valle, Mocho, and Corral Hollow.

Water Supply:

Development of additional water supply for camps at Thomas, Mitchell, Mocho, Indian Creek and Irvington Portal was accomplished by tapping some of the flows encountered in tunnel driving. These waters were subjected to sanitary test before being utilized for camp purposes. An additional well was dug at Corral Hollow to furnish water for the portable gravel plant which is now being erected there.

Wherever the Hetch Hetchy tunnels have been driven there have been claims from property owners that their springs have been affected. In some

cases the claims have been well founded and the City has recompensed the owners. Some claims are presented that are absolutely unwarranted. For several years engineers from the Livermore office have been measuring all springs near the aqueduct so as to be prepared to resist any unwarranted claims. The water shortage is aggravated by the succession of four dry winters, with consequent depletion of local ground water supply which has lowered the yield of all springs, in some places to complete stoppage. Complaints of diminution of spring flow are in all cases met by careful investigation and with full fairness to the complainant. The opinion of the consulting geologist is always of great weight in arriving at conclusions.

Gravel Plants:

The small sand and gravel plant has continued operation at Corral Hollow throughout the year. The material is stock-piled for use as aggregate for concrete lining of the tunnel. To date the plant has produced upward of 60,000 cubic yards of sand and gravel, of which over 10,000 cubic yards of sand have been used in placing gunite concrete.

The portable gravel plant with rated capacity of 100 tons per hour, purchased from the Link-Belt Co. under Contract No. 121, was put in service at Alameda Creek in November, 1930. It consists of a hopper and feeder unit, a scalping and crushing unit, and a screening and washing unit, with necessary connecting belt conveyors and storage belt conveyors to place



PORTABLE GRAVEL PLANT AT CORRAL HOLLOW

the classified aggregate in three stock piles. The plant is somewhat of a novelty and therefore required slight adjustments before being put into operation.

After several months of operation at Alameda Portals Camp where it was first installed and where it stored sufficient sand and gravel aggregate to line the west $8\frac{1}{2}$ miles of tunnel, the plant was moved to Corral Hollow where preparations for putting it into service are about complete.

During the year the mineral rights were purchased on an additional 33 acres of gravel lands in Corral Hollow.

Transmission Lines and Telephone System:

No extensive work was done on these systems during the year, but short leads were erected at Alameda Portals and Corral Hollow to serve the portable gravel plant.

Transformer capacity at Alameda Portals Camp was increased to take care of the portable gravel plant and additional pumps and blowers for the tunnel.

Both power lines and telephone lines have been very carefully maintained. Telephone lines connect all tunnel workings with the camp offices. These in turn are connected to the headquarters office and communication is possible at all hours.

Tunnel Driving:

Tesla Portal:

Tunneling was carried on continuously with good speed from the beginning of the year until November 27, 1930, when a flow of quicksand was encountered. This material developed very heavy pressure which crushed the timbers and filled the tunnel for 30 feet back from the heading. Efforts to advance the heading by use of steel liner plates were not successful and it was considered more economical to suspend the driving from the west and push eastward from Thomas Shaft heading. A small tunnel was driven into the quicksand at Tesla end to allow the water to drain from it, while the heading was being advanced from Thomas. The method was quite successful and the small heading drifts holed through on March 4, 1931. Enlargement of the small drift to full size was completed on March 16, 1931, the first of seven sections of the Coast Range Tunnel to be holed through. The distance from shaft to portal is 4.4 miles.

During the period from June 30 to November 27, 1930, when the quicksand was reached, the tunnel was advanced 2,158 feet through sandstone, large hard boulders, some gouge, sand, and gravel imbedded in clay.

The concrete lining operations which have just begun will be described later.

At Tesla Portal there will be an overflow shaft to prevent excessive pressure in the tunnel and to act as an air vent. Excavation of this shaft is complete and about 80% of its concrete lining has been placed by the gunite method. The shaft is used now to store gravel which is used for

backfill in the tunnel which is now being lined. This gravel is hauled to the shaft by trucks, and from the shaft into the tunnel by cars.

Several specimens of geological interest encountered in this tunnel have been donated to scientific institutions. Among these was an elephant's leg which was consigned to the museum of the University of California, and an ammonite or curved cephalopod shell which was placed in the custody of the museum of the Academy of Sciences in Golden Gate Park. Scientific authorities assert that this shell was formed on the bottom of the ocean or on the sea shore, 30 million years ago.

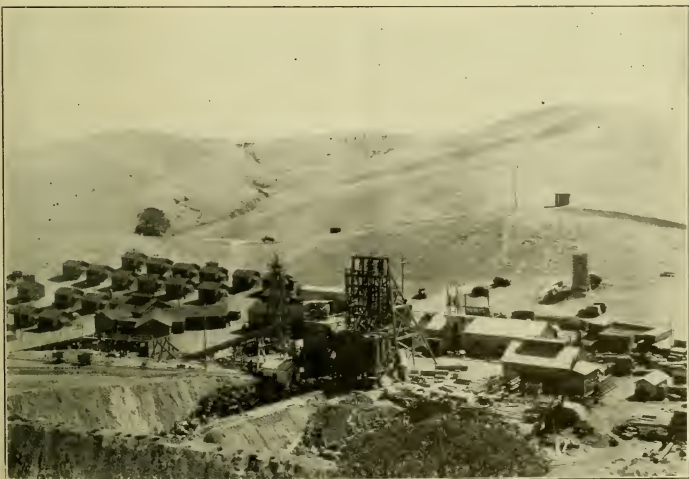
Thomas Shaft:

At Thomas Camp the following additional buildings were erected during the year:

- Cap lamp and battery house
- Extension to blower house
- Addition to cement shed
- Tool shed and shelter house.

Blower air in the tunnels was increased by the addition of a Roots No. 7½ high pressure blower with a capacity of 10,000 cubic feet per minute.

In the east heading from Thomas Shaft the tunnel was driven 4,406 feet from June 30, 1930 to March 16, 1931, when the drifts after being holed through had been enlarged to full section.



THOMAS CAMP

The material encountered was soft grey sandstone, soft black sandstone, black shale, and some broken schist. Gunitite concrete lining has been placed in 1479 feet of this tunnel.

In the west heading the tunnel was driven 2201 feet during the year, through broken shale with clay seams, broken chert with clay seams, and black gouge. Much of this was heavy, running ground which resulted in numerous shutdowns in order to catch up the ground and set new timber. The method of driving a small drift was resorted to a number of times. On the advice of the consulting geologist, a detour was made to reduce the distance driven through the troublesome chert and clay and increase the distance through sandstone which was more favorable for tunneling. Gunitite lining has been placed in 3063 feet of this tunnel.

This heading was shut down from July 23 to September 18, 1930 while waiting for permissible electric battery locomotives.

Mitchell Shaft:

During the year the following additions were made to the camp:

- First aid building
- Cap lamp and battery house
- Extension on blower house
- Extension on compressor house
- Bunkhouse for two men
- Bunkhouse for four men
- Ten five-men bunkhouses.

The east tunnel was driven 1850 feet through very difficult ground consisting of quartz, shale, chlorite schist and clay, red chert, and grey chert. Some of these formations swell and develop great pressure. At such times it is necessary to shut down the driving operations in the heading, and place gunitite concrete lining to hold the swelling ground. This lining serves the purpose perfectly. To date 891 feet of this tunnel have been lined with gunitite

Occasional heavy flows of methane have occurred in this tunnel and the work is prosecuted with the greatest caution. As was noted under the heading "Mine Rescue and First Aid," an explosion of methane occurred on July 17, 1930, in Mitchell Shaft. No satisfactory explanation of this explosion has been advanced but the coroner's jury acquitted the City from any responsibility.

After the explosion it was impossible to resume work until October 15, 1930.

The west heading also has often been troublesome on account of heavy pressure which has required gunitite concrete lining of which a total length of 1729 feet has been placed. Notwithstanding these difficulties the tunnel was advanced 2528 feet during the year, through soft chlorite schist, clay and gouge, hard quartz, schist boulders, broken sandstone, and broken shale and clay. After shutting down from July 17 to August 8, 1930 work was resumed, using air operated hoists and cables for haulage of muck cars.

Permissible locomotives were installed as soon as they could be procured after the fatal blast and the remaining part of the period has been free from explosions.

Mocho Shaft:

The camp was extended by construction of the following buildings during the year:

- 2 Four-men bunkhouses
- 1 Cap lamp and battery house
- 1 Extension to blower house.

The east heading was advanced 2233 feet through schist and black, broken shale, sandstone boulders, clay and gouge, and clay and chert. Heavy ground similar to that in the Mitchell headings has necessitated considerable lining with gunite, a total of 2009 feet having been placed.

This work was shut down from July 23 to October 8, 1930, while awaiting delivery of permissible locomotives and batteries.

The west heading progressed 2912 feet during the year, through schist and broken shale, chert and clay, and sandstone boulders. The total length of gunite lining is 366 feet.

A similar delay ensued here from July 23 to October 10, 1930 on account of difficulty in procuring permissible equipment.

Valle Shaft:

The following buildings were added to the camp during the year:

- 7 Five-men bunkhouses
- 1 Cap lamp and battery house
- 1 Extension to blower house
- 1 Cement shed
- 1 12-car garage.

The ventilating equipment was increased by installing a No. 7½ Roots high pressure blower with capacity of 10,000 cubic feet of air per minute. This blower is driven by a 200 horsepower motor.

In the east heading 2411 feet of tunnel were driven during the year. The formations encountered were sandstone, gravel with clay, and broken shale. Some of the ground develops great pressure and requires use of gunite lining, 86 feet of tunnel having been so lined.

In the tunnel floor at present there is a rock which appears to be disintegrated granite. This is of extreme interest to the geologist as the first occurrence of the "basement complex" in the Mt. Hamilton Range.

On July 23, 1930, driving in this heading was discontinued and was not resumed until receipt of permissible locomotives on March 5, 1931.

In the west heading the material encountered was principally schist boulders and black shale, badly broken up and developing great pressure which crushed timber. Nevertheless, 2748 feet of tunnel was driven during the year. In this section the gunite lining is carried very close to the head-

ing and is holding the ground well. A total length of 2004 feet has been lined with gunite.

The heading was shut down from July 23 to September 24, 1930.

Indian Creek Camp:

During the year the following buildings were added to the camp:

- 1 Cap lamp and battery house
- 1 Extension to blower house
- 1 Shelter house near headframe.

A No. 7½ Roots high pressure blower with capacity of 10,000 cubic feet of air per minute was installed.

The east heading was advanced 3,389 feet during the year. Materials encountered were shale, black gouge, clay seams, quartz, schist boulders, and broken quartz. Of the total length of this tunnel, 9182 feet, gunite lining has been placed in 3800 feet.

Work was discontinued from July 23 to August 16, 1930 while awaiting delivery of permissible equipment.

Progress for the year in the west heading was 877 feet. The material encountered was broken sandstone, clay, gravel, and sand. Driving was discontinued from July 23 to August 27, 1930 on account of difficulty in procuring permissible equipment.

On October 23, 1930, the west tunnel broke into a deposit of quicksand with a water flow of 3,000 gallons per minute which later diminished to 1,000 gallons. Sand to an amount of about 4,700 cubic yards, flowed into the tunnel, completely filling it for a distance of 2,500 feet and tapering off in depth to a few inches at the Indian Creek Shaft crosscut and station. On November 18, 1930, a second flow carried sand even into the east tunnel. The water flow slowly decreased to 450 gallons per minute and the sand was mucked out of the tunnel. When approaching the old face, a small drift was driven so as to drain the water from the sand. This was then widened to full width of tunnel and gunite concrete was placed to stabilize the roof. The tunnel is lined with gunite for a total length of 814 feet. It is the intention to bulkhead this tunnel and drive entirely from the east Alameda Creek end, in which event the remaining 1,148 feet will be driven through from that heading.

Alameda Portals:

The following additions to the camp buildings have been erected during the year:

- 1 Cap lamp and battery house
- 1 First Aid building
- 4 Five-men bunkhouses.

It was necessary to install an additional No. 5½ Roots blower as heavy flows of hydrogen sulphide were encountered in the east heading.

This tunnel progressed 3,540 feet during the year, principally through soft sandstone and clay. Heavy flows of water have caused extensive

grouting to seal them off. The water developed here now amounts to 890 gallons per minute. Heavy, swelling ground has necessitated considerable retimbering and use of gunite concrete lining, of which a total of 3,800 feet has been placed.

In the west heading 3,031 feet progress was made during the year. The materials encountered have been shale with large mud seams, and fractured, blocky sandstone with waterbearing seams. Water flows large enough to flood the tunnel have occurred but grouting of the seams has reduced these to about 370 gallons per minute. Retimbering and the catching up of caving ground have used considerable time. Only 184 feet of this tunnel have been lined with gunite. But 699 feet remain to be pierced between this tunnel and that from Irvington Portal. It is expected that the tunnels will hole through in August, 1931.

Irvington Portal:

A building for cap lamps and batteries was erected during the year. No additional equipment was necessary.

The tunnel was advanced 3,494 feet during the year, through broken shale and soft sandstone. Large amounts of water were encountered and grouting was required almost continuously to seal off these flows. At present the water flow is about 850 gallons per minute. There is no gunite lining in this tunnel.

Tunnel Lining:

As noted under "Tunnel Driving" it was advisable to place gunite concrete lining at many points in the tunnel to hold swelling ground. The aggregate length of such lining to date is 3.4 miles. This lining generally is built up to 1½ inches from finished line of tunnel so that a final plaster of gunite may be placed on the inside and finished smooth so as not to impede the flow of water.

Placing of concrete lining by the standard method employed on other tunnels heretofore completed was begun at Thomas Shaft on June 26, 1931. It is planned to complete the lining of the 4.4 mile section of tunnel from Tesla Portal to Thomas Shaft while the San Joaquin Pipe Line is under construction, so that if necessary it may be used as part of an emergency conduit over the Coast Range Mountains.

The driving of tunnel west from Thomas Shaft is being carried on simultaneously with the lining operations east from the shaft. To prevent interference between the two operations, an independent means of getting the concrete aggregate down to tunnel level was provided by drilling a well a short distance easterly from the shaft.

The well has a 10 inch extra heavy pipe casing through which the dry aggregate is delivered from the surface to cars in the tunnel. Each car has three compartments, each of which contains a batch for the 21 cubic foot mixer. A 5¼ sack per cubic yard mix is used with 21 to 24 gallons of water. Upon arriving close to the mixer, the cars are spotted one at a time



Dropping concrete aggregate through well to 3-compartment cars in tunnel



Incline for unloading cars of dry aggregate at mixer
TUNNEL CONCRETE LINING OPERATIONS



Screeding invert of 10'6" dia. tunnel
TUNNEL CONCRETE LINING OPERATIONS

and unloaded by batches to an inclined conveyor belt which carries the aggregate to the mixer where the water is added. The mixing and placing plant is portable, the entire outfit being mounted on trucks that ride on the regular tunnel track.

The mixed concrete is handled in buggies. At present only the invert is being placed; the sides and arch will be constructed subsequently. Construction joints between invert and arch are provided by use of steel forms. The circular section for the waterway is made by screeding by hand to circular steel templates. The concrete is smoothed by finishers who remove the templates and trowel the surface.

The placing of invert is now being carried on by one crew which removes track, cleans the tunnel bottom, and does other preparatory work, and by one concrete crew. It is proposed to add a second concrete crew as soon as possible.

The track is relaid as soon as the concrete sets, and is used for continuation of the lining operations. When the invert is complete to Tesla Portal the mixing and placing plant, to which there then will have been added a concrete gun, will travel back over the rails to Thomas Shaft, while placing concrete in the sides and arch of the tunnel.

To date 605 lineal feet of concrete invert have been placed. It is expected that by working two crews the daily progress will be about 600 feet.

Aqueduct, Bay Crossing Division

The Bay Crossing Pipe Line and Pulgas Tunnel continue in successful operation carrying water from east bay sources to the peninsular system of the Water Department. The diminished supply from the Alameda Creek sources has been partially compensated for by the 32 million gallons daily delivery at San Lorenzo from the system of the East Bay Municipal Utilities District to the Hetch Hetchy main near Newark. This positively assures the water supply of San Francisco.

City Reservoirs

As noted in previous Annual Reports, the safeguarding of our water supply requires the construction of additional receiving reservoirs within the City. Three such have been planned by this office and their sites have been partially acquired, but the Supervisors have not appropriated money for construction. The proposed reservoirs will have an aggregate capacity of 1,100,000,000 gallons, almost seven times the present capacity of the old Spring Valley distribution reservoirs within the city.

The unit selected for first construction is the Balboa Park or Ocean Avenue Reservoir to be located on a tract of 42 acres acquired by the City as part of the Spring Valley Water Company purchase. This land was bought by that company in 1893 for reservoir purposes but never developed.

Peninsular Water Supply

The condition of the water supply of the various communities on the bay slope of the peninsula is constantly becoming accentuated. Dwindling rainfall and steady increase in demand are combining to make the existing supply more and more inadequate. The obvious solution is to take water from San Francisco's systems, which can best be done by formation of one water district in San Mateo County to buy the water wholesale and then to retail it to its constituent units. The formation of such a district is not making very rapid progress.

Finance

The Hetch Hetchy project has been financed from the following bond issues:

- \$600,000 authorized in 1908 to purchase watershed lands and water rights.
- \$45,000,000 authorized in 1910 (before the Raker Act), which built the main dams, the mountain tunnels, Moccasin Power System, the Bay Crossing pipe line, and Pulgas Tunnel.
- \$10,000,000 authorized in 1924, for Foothill Tunnel and commencement of shaft sinking in the Coast Range.
- \$24,000,000 authorized in 1928 for San Joaquin Pipe line and completion of Coast Range Tunnels.

On October 7, 1930, bids were received on \$8,000,000 of Hetch Hetchy bonds along with \$2,400,000 of other City issues. The total premium was \$509,600.

There still remain unsold, \$4,000,000 bonds of the 1928 issue. These and the money now on hand are sufficient to complete the pipe line construction now under way, the proposed emergency pipe line over the Coast Range, the Red Mountain Bar pipe, the 1.3 mile pipe from Irvington Portal to connect with the present Bay Crossing pipe line, and to carry on the tunnel work until next spring.

Through resolutions of the Board of Supervisors sanctioned by the City Attorney, the following funds have been deflected from the Coast Range tunnel work fund:

East Bay emergency pipe.....	\$1,096,000
Mather-Hetch Hetchy road.....	250,000
July 27, 1931 Tesla Portal-Alameda Creek pipe.....	1,850,000
Total.....	<u>\$3,196,000</u>
Extra equipment and extra cost of Coast Range tunnels are estimated.....	<u>1,000,000</u>

Total amount necessary to be replaced in Hetch Hetchy
Bond Fund..... \$4,196,000

The operation of the Moccasin Power System with a revenue approximating \$2,000,000 annually and total receipts approximating \$14,000,000, the lease of the Bay Crossing Division to the Spring Valley Water Company and the San Francisco Water Department for \$250,000 annually for nearly six years with total earnings of more than \$1,300,000, and the interest earned exceeding \$3,600,000 on account of funds of the Hetch Hetchy project, have done much to lessen the amount of taxes levied in the City of San Francisco for water construction purposes. The healthy condition of finances is shown in the fact that for the fiscal years 1924-1925 to 1930-1931, the taxes apportioned to water purposes in San Francisco averaged 19 cents. From July 1, 1925 to June 30, 1931 the pro rata interest earnings of the funds of the Hetch Hetchy on account of treasury balances on deposit in banks has amounted to \$575,000, which sum is included in the receipts of the City's General Fund and not credited to Hetch Hetchy. This earning is an appropriate credit to the water construction bond interest and redemption fund and has averaged 1 cent in taxes. From the direct apportionment of taxes averaging 19 cents and the credit averaging 1 cent, there is derived a net of 18 cents as against 28 cents in the East Bay Municipal Utility District.

TOTALS PAID UNDER CONTRACTS

	1910 Fund	1925 Fund	1928 Fund	Totals
Contracts completed prior to July 1, 1930, brought forward from previous report.....	\$17,576,263	\$1,696,118	0	\$19,272,381
Contracts completed during fiscal year 1930-1931.....	8,359,999	0	0	8,359,999
Total, contracts completed to June 30, 1931.....	<u>25,936,262</u>	<u>1,696,118</u>	<u>0</u>	<u>27,632,380</u>
Contracts not yet completed....	0	675,658	711,766	1,387,424
Total amounts paid, all con- tracts	<u>\$25,936,262</u>	<u>\$2,371,776</u>	<u>\$711,766</u>	<u>\$29,019,804</u>

BUREAU OF ENGINEERING

CURRENT CONTRACT DATA, 1930-1931
Applying to Hetch Hetchy Water Supply

Contract Number and Title	Contractor	Date of Signing Contract	Time Allowed in Days	Date of Acceptance	Amount of Bid	Amount Paid	Bond Funds
77-C Driving and lining tunnels in Mountain Division on a cost-plus-fee basis	Construction Co. of North America	3/ 3/20	1000	9/10/30	\$7,802,952	\$8,359,999	1910
113-E Driving and lining tunnel in Brown Section, Foothill Division	Connolly and De Luca	9/28/26	700	a	779,745	675,658	1925
121 Furnishing and delivering portable gravel plant	Link-Belt Company	3/27/30	75	a	44,612	40,151	1928
122 Construction of Newark-San Lorenzo Pipe Line	Western Pipe and Steel Co. of Calif.	11/26/30	120	a	648,867	671,615	1928
123 Construction of San Joaquin Pipe Line	Youdall Construc- tion Company	6/11/31	365	Not completed	4,136,479		1928
124 Grading and surfacing Mather- Hetch Hetchy Road				b			1928

a. Actual construction completed. Formal acceptance not yet made.

b. Bids to be received July 8, 1931.

EXPENDITURES ON HETCH HETCHY PROJECT JUNE 30, 1931

1909 and 1910 Bond Funds Together With Amount Advanced From General Fund Prior to Bond Issues

Code	Account	Fiscal Year 1930-1931	Total to June 30, 1931
GENERAL EXPENDITURES			
2001	Preliminary Water Supply Investigations.....	\$	140,408.29
2002	Lands, Water Rights and Rights of Way.....	7,853.44	1,776,821.23
2003	Rentals to U. S. Government.....		106,018.11
2004	Legal Expense		179,818.03
2005	Hydrography	2,465.35	66,495.30
2006	City Office Administration.....		450,493.58
2007	City Office Engineering.....	6,361.16	386,351.52
2009	Taxes	7,021.68	91,936.98
2012	Unamortized Expense, Sale of Bonds.....		26,877.36
A-16	City Engineer's Revolving Fund.....	20,000.00*	
Total General Expenditures.....		\$ 3,701.63	\$ 3,225,220.40
CONSTRUCTION EXPENDITURES			
1000	Hetch Hetchy Railroad (Including Net Operation)	\$	2,743,093.02
2008	State Compensation Insurance, Undistributed		4,680.67
2010	Miscellaneous Construction Expenditures.....	35,854.55	61,753.12
2015	C. R. C. Evaluation, P. G. & E. & G. W. P. Co.'s Properties, San Francisco.....		355,207.66†
2017	Wells in Sunset and Richmond Districts.....		19,906.44
2018	Tourist Camp, Mather.....		52,740.31
2101	Groveland Office Administration and Engineering	7.47	258,498.47
2102	Groveland Hospital (Including Net Operation)		118,398.77
2110	Groveland Dwellings, Less Rents.....		68,413.77
2111	Groveland Warehouse		9,725.96
2112	Groveland Water Supply.....		33,784.65
2200	H. H. Div., O'Shaughnessy Dam & Appurtenances		8,161,928.83
2300	Lake Eleanor Div., Eleanor Dam & Appurtenances		391,747.22
2400	Mt. Div., Aqueduct Tunnels and Structures.....	49,928.41	10,642,786.42
2500	Priest Div., Dam, Reg. Reservoir & Pwr. Tun.		2,380,753.70
2600	Moccasin Div., Penstock, Pwr. Hse. & Struc.		4,874,065.98
2700	Foothill Div., Tuolumne R. Cross., Red Mt. Bar		285,009.63
2800	Lower Cherry Power Development (Including Net Operation).....		311,985.16
2900	Early Intake Diver. Works, Dam and Appurtenances		879,693.92
3000	Canyon Ranch & Mather Sawmills (Including Net Operation).....		147,538.30

Note: Asterisk (*) denotes credits.

See note, page 105.

**EXPENDITURES ON HETCH HETCHY PROJECT
JUNE 30, 1931**

1909 and 1910 Bond Issues and General Fund

Code	Account	Fiscal Year 1930-1931	Total to June 30, 1931
CONSTRUCTION EXPENDITURES (Continued)			
3200	H. H. Power Trans. System (Moccasin to Newark)	\$	\$ 1,788,044.56
3300	San Joaquin Div., Cost of Land and Surveys		214,664.12
3400	Coast Range Division, Preliminary Surveys.....		30.00
3500	Golden Rock Ditch (Less Water Sales).....		6,561.99
4000	Boarding House, Net Operation.....		302,351.94
5000	Materials and Supplies.....	51,503.36*	
6000	Bay Development (Newark to Pulgas) Incl. Lands	629.72	5,963,030.78
L-73	Electric Energy from H. H. Plants (Since 8/15/25)		287.71*
	Total Construction Expenditures.....	\$34,916.79	\$40,076,107.68

MISCELLANEOUS EXPENDITURES

A-13	Accounts Receivable—H. H. W. C. Fund (Issue of 1925)	\$30,992.21*	.....
	Total Miscellaneous Expenditures.....	\$30,992.21*	.....
	Gross Expenditures	\$ 7,626.21	\$43,301,328.08

REVENUES DURING CONSTRUCTION

500	Rental from Lands and Rights of Way.....	\$ 842.70	\$ 32,408.45
501	Sale of Water to Irrigation Districts.....		164,979.17
502	Use of Pipe Line, Bay Development.....		79,155.35
503	Miscellaneous Credits	38.25	8,765.17
	Total Revenues	\$ 880.95	\$ 285,308.14
	Net Expenditures	\$ 6,745.26	\$43,016,019.94

Note: Asterisk (*) denotes credits.

EXPENDITURES ON HETCH HETCHY PROJECT JUNE 30, 1931

1909 and 1910 Bond Issues and General Fund

Reconciliation of Statement of Expenditures With Consolidated Statement of Funds

Disbursements as Per Consolidated Statement of Funds:

1909 Bond Issue.....	\$ 603,033.87		
1910 Bond Issue.....	42,914,359.31		
General Fund	118,219.93		
Hetch Hetchy Operative Revenue Fund	\$1,967,969.00		
Transfer to Bond Interest Fund	620,000.00*	1,347,969.00	\$44,983,582.11

Receipts Used as Reduction of Expenditures:

Operation of Hetch Hetchy R. R.....	\$1,380,876.87		
Sale of Power, Lower Cherry Power Development	386,338.54		
Sale of Water.....	166,324.50		
Use of Pipe Line, Bay Develop- ment (S.V.W.Co.)..	\$79,155.35		
Less non-cash item..	54,554.57	24,600.78	
Miscellaneous	4,093.31	1,962,234.00	
Non-cash items used as reduction of expenditures	5,328.17		1,967,562.17

NET EXPENDITURES AS PER DETAILED STATEMENT

(Page 104)..... \$43,016,019.94

Note: The foregoing expenditures include the sum of \$355,207.66 (Account 2015, page 103) which was paid out of the Hetch Hetchy Operative Revenue Fund for valuation of Pacific Gas and Electric Company's and Great Western Power Company's Plants. This charge is not a true Hetch Hetchy Project expenditure and should be deducted when calculating the actual costs of the project.

Note: Asterisk (*) denotes credit.

EXPENDITURES ON HETCH HETCHY PROJECT

JUNE 30, 1931

1925 and 1928 Bond Issues

Code	Account	Fiscal Year 1930-1931	Total to June 30, 1931
MOUNTAIN DIVISION			
1904	Roads, Trails and Tramways.....	\$ 14.78	\$ 14.78
2104	Groveland Hospital—Operating Expenses....	560.41	560.41
2407	Aqueduct Tunnels	326.10*	326.10*
Total		\$ 249.09	\$ 249.09
FOOTHILL DIVISION			
2700	Division Administration and Engineering	867.51	196,236.53
2701	Preliminary Investigations and Surveys....	.....	31,587.79
2702	Field Engineering and Inspection.....	481.95	205,129.87
2703	Camps	379.21*	229,039.67
2704	Roads, Trails and Tramways.....	275.84	180,874.14
2705	Adits	2,625.62	14,209.41
2706	Shafts .....	.....	130,037.96
2707	Aqueduct Tunnels	29,064.50	6,210,541.47
2708	Tuolumne River Crossing at Red Mt. Bar..	2,243.71	3,549.92
2709	Aqueduct Tunnels—Main Control Tower....	2.50*	39,815.09
2710	Aqueduct Diversion Dam and Appurte- nances	229.29*	507,230.94
2711	Moccasin Creek Diversion Dam.....	.....	77.09
2712	Moccasin and Grizzly Creek Diversion.....	500.16	89,711.80
2714	Miscellaneous Jobbing and Sales Account	1,079.91*	.....
2718	Lands and Right of Way.....	1,834.06	71,818.10
2719	Power Trans. Line for Constr. Purposes.....	86.72	54,807.05
2720	Div'n Administration Bldgs. & Equipment.....	237.53*	54,012.99
2721	Division Hospital (Incl. Operation).....	3,827.09*	84,582.21
2722	Materials and Supplies.....	6,889.27*	.....
2723	Div. Misc. Shops & Equip. (Incl. Oper.)....	2,980.06*	.....
2724	Div. Garage Equip. (Incl. Oper.).....	500.00*	.....
2726	Div. Communication System.....	236.83	20,773.93
2727	Camp Operation (Incl. Boarding House)....	.....	131,191.26
2792	General Administration	3,375.21	159,076.89
2793	General Engineering	4,979.95	134,136.23
2794	Law Expense During Construction.....	.....	5,431.38
2797	Misc. Construction Expenditures.....	101.73*	2,613.60
L-73	Electric Energy from Hetch Hetchy Plants	53.49*	178,151.91*
Total		\$ 30,291.98	\$ 8,378,333.41
SAN JOAQUIN DIVISION			
3300	Div. Administration and Engineering.....	\$ 390.95	\$ 390.95
3301	Preliminary Investigations and Surveys....	7,022.44	11,191.09
3302	Field Engineering and Inspection.....	17,254.51	19,222.03
3318	Lands and Rights of Way.....	2,676.03	6,781.78
3320	Div. Administration Bldgs. & Equip.	52.50*	.....

Note: Asterisk (*) denotes credit.

Code	Account	Fiscal Year		Total to
		1930-1931		June 30, 1931
SAN JOAQUIN DIVISION (Continued)				
3392	General Administration	\$	3,316.95	\$ 3,316.95
3393	General Engineering		13,295.41	13,295.41
Total		\$	43,903.79	\$ 54,198.21
COAST RANGE DIVISION				
3400	Div. Administration and Engineering.....	\$	74,640.98	\$ 200,019.11
3401	Preliminary Investigations and Surveys.....			52,571.94
3402	Field Engineering and Inspection.....		90,226.32	231,753.35
3403	Camps		25,922.89*	361,617.70
3404	Roads, Trails and Tramways.....		15,070.21	131,927.05
3406	Shafts		4,345.39	738,350.71
3407	Aqueduct Tunnels.....		4,558,699.78	9,604,030.96
3409	Alameda Creek Crushing Plant.....		150,651.86	152,177.20
3414	Misc. Jobbing and Sales Account.....		2,037.19	2,334.49
3416	Div. Shops & Equip. (Incl. Operation).....		35,060.87*	47,049.81
3417	Div. Warehouse (Incl. Operation).....		11,418.33*	28,088.66*
3418	Lands and Rights of Way.....		27,755.76	125,453.88
3419	Power Trans. Line for Constr. Purposes....		6,808.19	247,684.87
3420	Div. Administration Bldgs. and Equip.....		444.49	16,734.91
3421	Div. Hospital (Incl. Operation).....		10,204.08	168.19
3422	Materials and Supplies.....		62,571.24*	618,399.81
3424	Div. Garage Equipment (Incl. Operation)..		9,433.41	21,903.55
3426	Div. Communication System.....		5,217.68	30,598.81
3427	Camp Operation (Incl. Boarding House)....		59,222.49*	1,259.98*
3492	General Administration		53,676.92	131,496.55
3493	General Engineering		33,210.47	117,581.75
3494	Law Expenses During Construction.....		50.00	375.60
3496	Taxes During Construction.....			15.27
3497	Misc. Construction Expenditures.....		1,091.93*	15,447.06
L-73	Electric Energy from Hetch Hetchy Plants		132,803.63*	238,601.58*
L-79	Mat. and Sup. Acquired Without Chg.....		61,492.53*	61,492.53*
Total			\$4,652,888.82	\$12,518,249.82
TESLA-SUNOL PIPE LINE				
5801	Preliminary Investigations and Surveys....	\$	585.34	\$ 585.34
5892	General Administration		28.45	28.45
5893	General Engineering		147.41	147.41
Total		\$	761.20	\$ 761.20
NEWARK-SAN LORENZO PIPE LINE				
5902	Field Engineering and Inspection.....	\$	23,679.76	\$ 23,679.76
5907	Lake Chabot Filters and Connections.....		2,341.63	2,341.63
5908	Pipe Line—36 and 44 inch.....		683,907.50	683,907.50
5909	Pipe Line—30 inch.....		123,446.16	123,446.16

Note: Asterisk (*) denotes credit.

Code	Account	Fiscal Year 1930-1931	Total to June 30, 1931
NEWARK-SAN LORENZO PIPE LINE (Continued)			
5910	Pumping Plant	\$ 52,518.85	\$ 52,518.85
5918	Lands and Rights of Way.....	75,056.54	75,056.54
5924	Garage Equipment	3,150.54	3,150.54
5992	General Administration	3,418.61	3,418.61
5993	General Engineering	2,246.10	2,246.10
Total		\$ 969,765.69	\$ 969,765.69

BAY CROSSING DIVISION

6002	General—Lands and Rights of Way.....	\$ 1,735.98	\$ 1,735.98
6013	General—Mtce. of Structures.....	30.10	30.10
6102	Irvington Pipe Connection.....	185.11	185.11
6118	Newark Section—Lands and Rights of Way	2,750.57	2,750.57
		\$ 4,701.76	\$ 4,701.76

GENERAL AND MISCELLANEOUS

A-9	Hetch Hetchy Payroll Revolving Fund.....	\$ 13,000.00*	\$ 93,000.00
A-12	Accts. Receivable—Miscellaneous Debtors	1,254.47	8,312.30
A-16	City Engineer's Revolving Fund.....	18,000.00	28,000.00
A-18	Remittances in Transit	15,232.96*	50,207.11
A-23	Special Funds—With Auditor for Acquisition of Rights of Way.....	25,608.22	25,608.22
A-25	Unamortized Disc. on Securities & Expense		
	H. H. W. C. Bonds (Issue of 1925).....		6,461.00
	H. H. C. Bonds (Issue of 1928).....	1,950.00	17,206.77
Total		\$ 18,579.73	\$ 228,795.40
Gross Expenditures to June 30, 1931.....		\$5,721,142.06	\$22,155,054.58

REVENUES DURING CONSTRUCTION

500	Rental From Lands and Rights of Way....	\$ 2,877.35	\$ 2,877.35
503	Miscellaneous Credits	98.81	98.81
Total Revenues		\$ 2,976.16	\$ 2,976.16
NET EXPENDITURES		\$5,718,165.90	\$22,152,078.42

Note: Asterisk (*) denotes credit.

**Reconciliation of Statement of Expenditures With Consolidated
Statement of Funds—1925 and 1928 Funds**

Disbursements as Per Consolidated Statement of Funds:

1925 Bond Fund.....	\$10,107,211.00	\$
1928 Bond Fund.....	11,709,219.24	21,816,430.24

Accounts Taken Into Expenditures as of June 30, 1931:

(not taken up by Auditor until after July 1, 1931)

Accounts Payable, Vouchers Audited but Not Paid	102,052.97	
Purchase Order Liability.....	177,242.25	
Accounts Payable, Due on Contracts 113A, 121 and 122	8,761.20	
Accounts Payable, Hetch Hetchy Power Op- erative Fund	115.21	
Accounts Payable, Miscellaneous Creditors....	4,301.97	
Accounts Payable, S. F. City Employees' Re- tirement System	744.16	
Accrued on account of Compensation Ins. Premiums	23,786.28	
Accrued on account of royalties—concrete gun	18,644.14	335,648.18

Net Expenditures as Per Detailed Statement (Page 108).....\$22,152,078.42

EXPENDITURES ON HETCH HETCHY PROJECT

JUNE 30, 1931

Hetch Hetchy Operative Revenue Fund

Total Receipts.....		\$ 1,967,969.00
Transferred to Bond Interest Fund.....	\$ 620,000.00	
Transferred to P. G. & E. & G. W. P. Cos'.		
Evaluation	355,207.66	
Transferred to H. H. 1910 Water Constr. Fund	992,761.34	1,967,969.00

Hetch Hetchy Power Operative Fund

CONDENSED BALANCE SHEET

Assets and Other Debits:		
Investment in Fixed Capital.....		\$25,750,404.63
Through 1909 & 1910 Bond Issues and General Fund.....	\$25,320,702.58	
Additions & Betterments from Appropriated Surplus	429,702.05	
Current and Accrued Assets.....		299,824.54
Special Funds (Depreciation).....		559,614.93
Deferred Charges.....		1,188,180.39
Total Assets and Other Debits.....		\$27,798,024.49
Liabilities and Other Credits:		
Capital and Long Term Debt.....		\$21,801,137.54
Balance of Bonded Debt Allocated to Power, 8/16/25 \$19,971,000.00		
Less: Redemptions from appropriated Income.....	3,072,600.00	
Bonds Outstanding,		
6/30/31	\$16,898,400.00	
Advances from Other Funds:		
Allocated to Power.....	6,958,000.09	
Less: Returned from appropriated Income and Excess Appropriations	2,055,262.55	
Advances Not Returned....	4,902,737.54	
Current and Accrued Liabilities.....		33,887.33
Reserve for Depreciation.....		858,463.12
Surplus from Income.....		5,104,536.50
Balance June 30, 1930.....	4,448,073.46	
Net Income, Fiscal Year 1930-1931.....	656,463.04	
Total Liabilities and Other Credits.....		\$27,798,024.49

EXPENDITURES ON HETCH HETCHY PROJECT JUNE 30, 1931

Hetch Hetchy Power Operative Fund

INCOME STATEMENT

	Fiscal Year 1930-1931	Total to June 30, 1931
Income from Operating Properties:		
Operating Revenues:		
Moccasin Power House.....	\$ 7,246,927.78	\$46,754,738.19
Early Intake Power House.....	32,473.15	251,710.88
Total Operating Revenues.....	\$ 7,279,400.93	\$47,006,449.07
Operating Expenses:		
Production	218,645.00	998,060.75
Transmission	26,444.95	150,323.19
Distribution		152.45
Commercial Department	5,294,862.04	34,159,881.20
General & Miscellaneous.....	235,318.80	1,223,070.72
Total Operating Expenses.....	\$ 5,775,270.79	\$36,531,488.31
Net Operating Revenue.....	1,504,130.14	10,474,960.76
Deduct Taxes Assignable to Operations.....	4,536.19	26,777.55
Net Operating & Gross Income.....	1,499,593.95	10,448,183.21
Deductions from Gross Income:		
Interest on Long-term Debt.....	783,472.50	4,936,662.00
Miscellaneous Interest Deductions.....		46,225.12
Amortization of Debt Discount & Expense.....	59,658.41	360,759.59
Total Deductions.....	\$ 843,130.91	\$ 5,343,646.71
Net Income.....	\$ 656,463.04	\$ 5,104,536.50
Charter Requirements for Comparison:		
Net Income as above.....	\$ 656,463.04	\$ 5,104,536.50
Add, Revenue chg'd H. H. W. S. Construction....	132,857.12	417,041.20
	789,320.16	5,521,577.70
Deduct, Taxes.....	99,542.53	694,804.57
Net Income After Comparison Items.....	\$ 689,777.63	\$ 4,826,773.13

EXPENDITURES ON HETCH HETCHY PROJECT JUNE 30, 1931

Addenda

Earnings from funds and completed units of the Hetch Hetchy Project which are not included in the foregoing schedules. These earnings have contributed in no small way to ease the tax payers' burden.

BAY DEVELOPMENT

Interest during construction, Apr. 18, 1922, to Apr. 17, 1925.....					\$ 228,683.59
Revenues from use of pipe line, Sept. 19, 1925, to June 30, 1931.....					\$1,329,155.35
Less amount reported on Page 105....					79,155.35
					<hr/>
					1,250,000.00
Discount in accordance with Order of California Railroad Commission of Dec. 18, 1924 (Decision 14379) and Ordinance 6447 of Board of Super- visors approved Dec. 22, 1924					\$174,925.45
Less Non-cash Item.....	58,316.09	116,609.36	1,133,390.64	\$1,362,074.32	

INTEREST RECEIVED ON ACCOUNTS RECEIVABLE, SURPLUS FUNDS INVESTED AND BANK BALANCES

Account of 1910 Water Construction Fund, July 1, 1919, to June 30, 1926.....					\$2,935,212.83
Account of 1925 Hetch Hetchy Water Construction Fund, July 1, 1925, to June 30, 1930.....					171,319.95
Account of 1928 Hetch Hetchy Construction Fund, October 1, 1928, to June 30, 1931.....					238,305.04
Account of Hetch Hetchy Power Operative and Hetch Hetchy Power Depreciation Funds, Octo- ber 1, 1925, to June 30, 1931.....					274,443.79 3,619,281.61
					<hr/>
Total Earnings.....					\$4,981,355.84

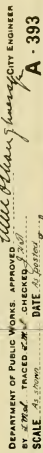
Disposition has been made as of July, 1931, of
the earnings as follows:

To Bond Interest and Bond Redemption Funds.....	\$3,522,511.28
General Fund.....	575,453.92
1910 Water Construction Fund.....	883,390.64
	<hr/>
	\$4,981,355.84

HETCH HETCHY PROJECT
CONSOLIDATED STATEMENT OF FUNDS - JUNE 30, 1931

	BOND ISSUES				General Fund	H. H. Operative Revenue Fund	Hetch Hetchy Power Depreciation Fund		TOTALS
	1909	1910	1925	1928			Operative Fund	Fund	
RECEIPTS:									
Par Value of Bonds Sold	600,000.00	45,000,000.00	10,000,000.00	20,000,000.00					75,600,000.00
Add Premiums, Sale of Bonds	3,050.00	11,338.00	107,211.00	687,000.00					808,609.00
Deduct Discount "		2,980,326.55							2,980,326.55
Net Proceeds " " "	603,050.00	42,031,021.45	10,107,211.00	20,687,000.00	118,151.02				73,438,282.45
Advanced from General Fund									
Transferred from 1909 and 1910					68.91				118,151.02
Funds to General Fund	16.13*	52.78*				5,735.00			5,735.00
Interest Earned on Funds Invested									
Advance Payments by Spring District " " "									
Direct " " "									
Non-cash " " "		883,390.64							883,390.64
Operation of Hetch Hetchy Railroad						1,380,876.87			1,380,876.87
Sale of Power, Lower Cherry Power Development						386,338.54			386,338.54
Sale of Waterline, Bay View Development						106,334.50			106,334.50
Miscellaneous						24,600.78			24,600.78
Operating Revenues						4,093.31			4,093.31
Depreciation Reserve Transferred from Operative						12,640,898.62			12,640,898.62
TOTAL RECEIPTS	603,033.87	42,914,359.31	10,107,211.00	20,687,000.00	118,219.93	1,967,969.00	958,333.00*	958,333.00	89,038,691.73
DISBURSEMENTS:									
For construction of project and operation of utilities									
For construction of Hetch Hetchy Dam, which is shown as a transfer above	603,033.87	42,914,359.31	10,107,211.00	11,709,219.24	118,219.93	992,761.34	1,947,806.53		68,392,611.22
For charges to Depreciation Reserve								98,718.07	98,718.07
For Bond Interest, transferred to Bond Interest Funds						620,000.00	7,578,971.00		8,198,971.00
For Bond Redemption, transferred to Bond Redemption Funds							2,129,029.00	300,000.00	2,429,029.00
For Calif. Railroad Commission Evaluation (P.G. & E. & G.W.P. Plants in San Francisco)						355,207.66			355,207.66
TOTAL DISBURSEMENTS	603,033.87	42,914,359.31	10,107,211.00	11,709,219.24	118,219.93	1,967,969.00	11,655,806.53	398,718.07	79,474,536.95
AUDITOR'S AVAILABLE BALANCES, JUNE 30, 1931:									
Cash				8,678,327.22			26,759.09		9,264,901.24
Investment Securities				299,253.54					299,253.54

* Indicates deductions



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